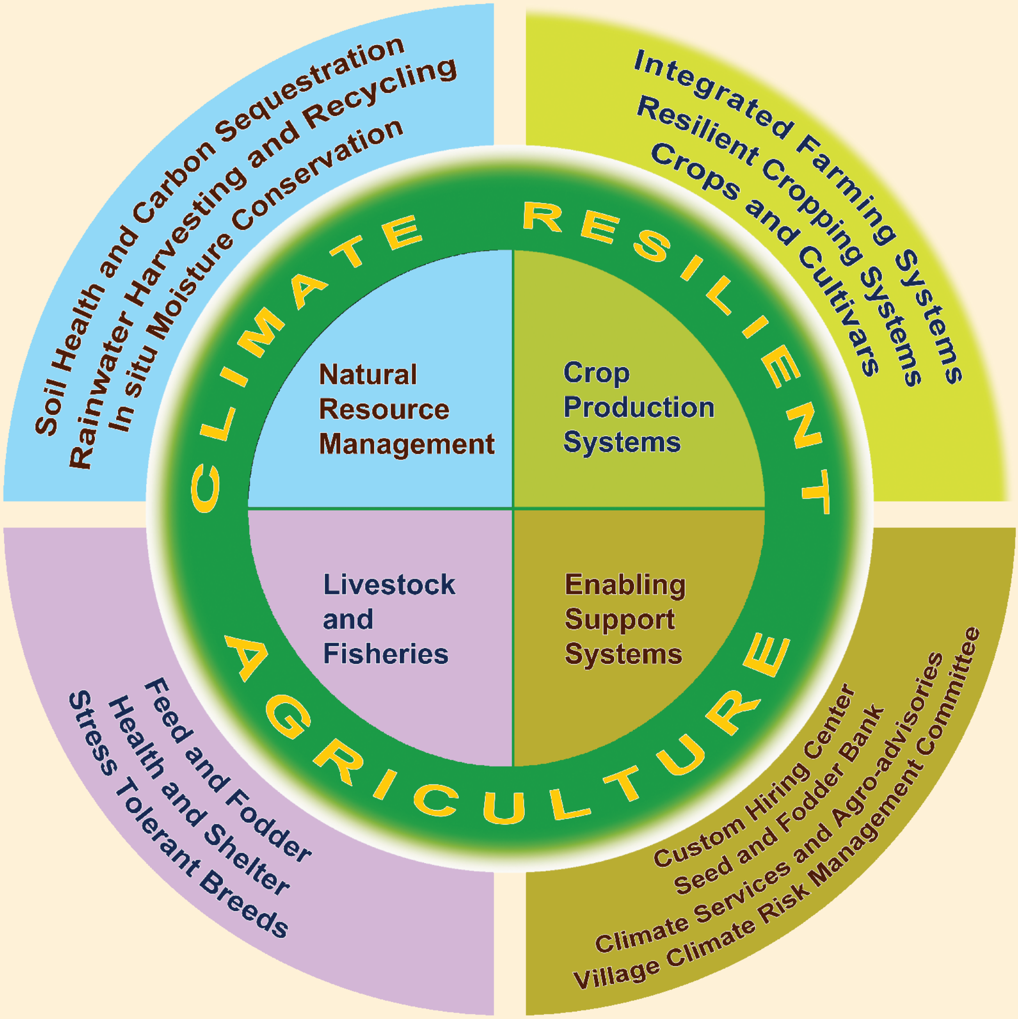
Highlights
2014-15

Technology Demonstrations

Enhancing resilience and adaptive capacity of farmers to climate variability



NICRA

ICAR-Central Research Institute for Dryland Agriculture, Hyderabad
Natural Resource Management & Agricultural Extension Divisions
Indian Council of Agricultural Research (ICAR), New Delhi

Technology Demonstrations

Enhancing resilience and adaptive capacity of farmers to climate variability

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FOREWORD

South West monsoon rainfall in 2014 was below normal for the country as a whole and the seasonal rainfall was deficient in the north-west and southern peninsular regions. About 46% of the districts in the country received deficit / scanty rainfall in June which adversely impacted timely sowing of several rainfed crops such as pulses, millets, oilseeds and cotton. The aberrant rainfall situation was both a challenge and opportunity to test the resilience potential of several technologies under the National Innovations in Climate Resilience Agriculture (NICRA) project implemented at 100 climatically vulnerable districts across the country through Krishi Vigyan Kendras (KVKs) of ICAR.

Integrated action plans demonstrating resilient practices and technologies in natural resource management, crop, livestock and fisheries production systems showed promise at several locations. Monsoon action plans were prepared and implemented by NICRA KVKs that faced an unfolding drought like situation during the season. Some of the successful interventions from implementing contingency crop planning at the village level include introduction of drought tolerant and short duration varieties, resilient intercropping systems in place of sole crops after mid July, adoption of *in situ* soil moisture conservation practices at the time of sowing in several NICRA villages in Maharashtra, Telangana, Andhra Pradesh, Madhya Pradesh, Uttar Pradesh, Punjab, Haryana, Rajasthan and Gujarat. Resilience created through on-farm water management at individual farmer and community level coupled with efficient use led to improved performance of rainfed crops at several locations during *kharif* and also facilitated compensatory production during the *rabi* season. Demonstration of location specific fodder production and its storage by silage making addressed fodder needs during the lean season in deficit rainfall districts in Maharashtra, Andhra Pradesh and Gujarat. In districts affected by extreme events (hudhud cyclone), timely advisories to minimize further damage were issued and demonstrated to farmers in NICRA villages. Zero till sown wheat in rice residue in Punjab and Haryana suffered less damage due to lodging and water logging at the time of maturity during unseasonal rains experienced in March, 2015 compared to conventionally sown wheat.

I am happy to note that technology demonstration component is expanded to 21 new districts from *kharif* 2015 as approved in the XII Plan. I congratulate the team at ICAR-CRIDA and Agricultural Technology Application Research Institutes (ATARIs) and compliment all the participating farmers and KVKs for bringing out the highlights of technology demonstrations. Let us take forward some of the scalable interventions for upscaling under the National Mission on Sustainable Agriculture (NMSA) to enhance resilience and adaptive capacity of our farmers to face the increasing challenges of climate variability in agriculture.

Dated the 6th August, 2015
New Delhi

(S. AYYAPPAN)

PREFACE

In the context of climate variability, farmers need to adapt quickly to increasing frequency of drought, flood and other extreme events to stabilize crop yields and farm income. Over the years, the National Agricultural Research System has developed an array of practices and technologies to foster stability in agriculture production against the onslaught of seasonal variations. Technology Demonstration Component (TDC) of NICRA offers great opportunity to work with farmers and apply such technologies under field conditions to address current climate variability. This will enhance the pace of adoption of these resilient technologies. On-farm participatory demonstrations for climate resilience are being implemented in village clusters through KVKs in 121 climatically vulnerable districts across the country and by 7 core research institutes of ICAR. The emphasis has been on capturing and improving the understanding on performance of technologies in different agro-ecologies and farming systems. This also facilitates identification of what constitutes climate resilience in different bio-physical and socio-economic contexts.

In 2014-15, the south west monsoon rainfall was below normal. Delay in onset and deficit rainfall conditions affected sowings and performance of standing crops in several rainfed districts in Maharashtra, Andhra Pradesh, Telangana, Karnataka, Madhya Pradesh, Uttar Pradesh, Gujarat and Rajasthan. NICRA KVKs prepared and implemented village level contingency crop plans and measures. This publication documents some of the successful climate resilient interventions which enhanced the coping ability of famers in different districts. Extreme events were also experienced during the year and some promising resilient practices were identified in the affected districts.

Work on evolving a framework for climate resilient villages (CRVs) and quantifying resilience was initiated during the year. Capacity development program for scientists from all participating KVKs was undertaken. About 36 KVKs were monitored by Zonal Monitoring Committees to suggest improvements in technology demonstrations. About 722 courses in different thematic areas of climate resilience were taken up for awareness and capacity building of participating farmers. Video documentation to capture the climate resilient interventions in action was initiated for widespread dissemination of project achievements. Performing KVKs in each Zone and farmers in all the NICRA villages were recognized and awarded. Village level carbon balance studies were completed for Gujarat and Rajasthan. An orientation workshop was organized for 21 new KVKs joining the Technology Demonstration Component in the XII Plan.

The aim of Technology Demonstration Component of NICRA is to mainstream successful resilient practices and technologies and a NICRA-NMSA interface meeting was organized for this purpose. We take this opportunity to gratefully acknowledge the constant guidance and support from Dr. S. Ayyapan, Secretary, DARE & DG, ICAR and members of the HLMC, and appreciate the valuable contribution of network partners including Farmers, VCRMC members, Scientists and Department officials.

Authors

Executive Summary

Several NICRA project sites experienced deficit rainfall conditions in 2014 during the south west monsoon season. Delayed onset and deficit rainfall adversely affected the sowings and crop performance especially of soybean, cotton, groundnut short duration pulses and millets in several rainfed states and districts.

Technology demonstration component of NICRA was implemented in village clusters by KVKs in 100 climatically vulnerable districts and by 7 core research institutes. Drought, floods, cyclone and unseasonal rainfall were the major climatic events that were experienced during 2014-15. A number of climate resilient practices and technologies were demonstrated in the village clusters in natural resource management, crop production systems, livestock & fisheries and institutional interventions. Rainwater harvesting and recycling potential created in NICRA villages in rainfed districts increased the resilience of crop production both in *kharif* and *rabi* seasons despite deficit rainfall. About 1572 demonstrations covering 1360 ha were taken up during 2014-15. About 918 demonstrations on improved planting methods in several *kharif* and *rabi* crops showed promise in enhancing resilience with higher productivity and income. About 594 demonstrations on zero till cultivation in *rabi* crops indicated its potential as a sustainable alternative to conventional planting of wheat, lentil, mustard, maize and vegetable crops. In the North Eastern states, sustainable intensification in rice fallows was demonstrated with the adoption of zero till sowing / raised and sunken bed planting method for cultivation of grain legumes and vegetable crops.

Monsoon action plans were prepared by NICRA-KVKs and implemented in 60 village clusters across districts that experienced an unfolding drought like situation. Contingency crop plans for delayed planting (after mid July) involving appropriate crop and soil moisture management measures were implemented. Contingency crops such as sesame, castor, blackgram, pigeonpea, sunflower, foxtail millet, pearl millet, horsegram, cluster bean, toria and basmati rice were adopted by farmers at different locations. About 3000 demonstrations of short duration and stress tolerant cultivars and resilient intercropping systems in place of sole crops contributed to stabilizing productivity in vulnerable districts. Demonstration of location specific fodder production and its storage by silage making addressed fodder needs during the lean season in deficit rainfall districts in Maharashtra, Andhra Pradesh and Gujarat. In districts affected by extreme events (hudhud cyclone), timely advisories to minimize further damage were issued and demonstrated to farmers in NICRA villages. Soil moisture deficit induced blossom end rot was successfully corrected by application of deficient nutrient. Zero till sown wheat in rice residue in Punjab and Haryana suffered less damage due to lodging and water logging at the time of maturity during unseasonal rains experienced in March, 2015 compared to conventionally sown wheat.

Village Level Climate Risk Management Committees (VCRMC) managed Custom Hiring Centers for farm implements and generated a revenue of Rs 8 lakhs. Work on evolving a framework for climate resilient villages (CRVs) and quantifying resilience was initiated during the year. Capacity development program for scientists from all participating KVKs was undertaken. About 36 KVKs were monitored by Zonal Monitoring Committees to suggest improvements in technology demonstrations. About 722 courses in different thematic areas of climate resilience were taken up for awareness and capacity building of participating farmers. Video documentation to capture the climate resilient interventions in action was initiated for widespread dissemination of project achievements. Performing KVKs in each Zone and farmers in all the NICRA villages were recognized and awarded. Village level carbon balance studies were completed for Gujarat and Rajasthan. An orientation workshop was organized for 21 new KVKs joining the Technology Demonstration Component in the XII Plan. An ICAR-DAC interface workshop on NICRA-NMSA was organized in which 27 proven climate resilient practices and technologies were identified for up-scaling.

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1. Introduction

The Indian Council of Agricultural Research (ICAR) launched the National initiative to enhance the resilience of Indian agriculture to climate change in February, 2011 during the XI plan period. The National Innovations in Climate Resilient Agriculture (NICRA) project in the XII plan (2012-17) is continuing with the following objectives:

1. To enhance the resilience of Indian agriculture including allied sectors to climatic variability and climate change through development and application of improved production and risk management technologies.
2. To demonstrate site specific technology packages on farmers' fields for adapting to current climate risks
3. To develop a knowledge management portal for dissemination of information to all stakeholders on climate change impacts on Indian agriculture.
4. To undertake capacity building of different stakeholders.

The NICRA project comprises of four components viz., 1) Strategic research on adaptation and mitigation, 2) Technology demonstration on farmers' fields to cope with current climate variability, 3) Sponsored and competitive research grants to fill critical research gaps, and 4) Capacity building of different stake holders.

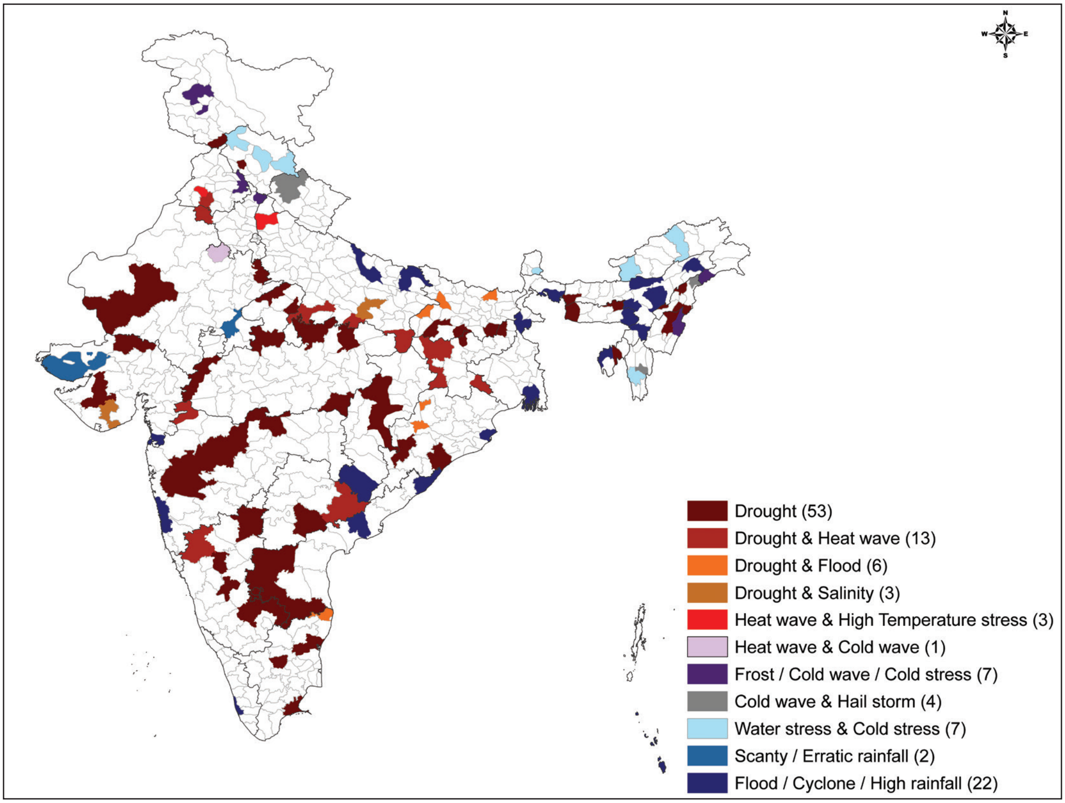
The Technology Demonstration Component (TDC) is aimed at enhancing the resilience and adaptive capacity of farmers to cope with the increasing climate variability in different agro-ecosystems. TDC is designed as a blend of both 'bottom-up' and 'top-down' approaches in targeting location-specific climate resilient practices and technologies eliciting active participation and empowerment of farmers. At the national level, TDC is coordinated by ICAR-CRIDA, Hyderabad. TDC project sites are located in 100 climatically vulnerable districts implemented by Krishi Vigyan Kendras (KVKs) coordinated at the zonal level by 8 Agricultural Technology Application Research Institutes. All the 121 sites are spread across the country in 28 states and one Union Territory (A & N islands) (Table1). In the recently approved XII plan, TDC has been expanded to 21 new districts for implementation through KVKs from 2015-16 onwards. In addition to implementation by NICRA KVKs, 7 Transfer of Technology (TOT) divisions of ICAR core institutes (IARI, NDRI, IIHR, CMFRI, CIAE, CRIDA and ICAR Research Complex NEH) carryout demonstrations of climate resilient technologies in their adopted villages.

Table 1: Participating KVKs in different Zones across the country

ATARIs	States & No. of districts	NICRA-KVKs (No.)		
		XI Plan	XII Plan	Total
Zone I, Ludhiana	Haryana (2), HP (4), J & K (3), Punjab (4)	12	1	13
Zone II, Kolkata	A & N Islands (1), Bihar (7), Jharkhand (6), West Bengal (3)	15	2	17
Zone III, Barapani	Arunachal Pradesh (3), Assam (5), Manipur (3), Meghalaya (3), Mizoram (2), Nagaland (4), Sikkim (1), Tripura (2)	17	6	23
Zone IV, Kanpur	Uttar Pradesh (13), Uttarakhand (2)	13	2	15
Zone V, Hyderabad	AP (5), Telangana (2), Maharashtra (8)	13	2	15
Zone VI, Jodhpur	Rajasthan (5), Gujarat (5)	7	3	10
Zone VII, Jabalpur	Chhattisgarh (3), Madhya Pradesh (9), Odisha (5)	14	3	17
Zone VIII, Bengaluru	Tamilnadu (4), Karnataka (6), Kerala (1)	9	2	11
Total	28 States + 1 UT	100	21	121

** Additionally, TDC is implemented at 7 sites by core research institutes*

As part of the technology demonstration component, 121 climatically vulnerable districts were identified based on a scientific analysis of climate constraints, farmers' experiences and perceptions following a bottom-up approach. The climate vulnerabilities identified include drought, flood, cyclone, heat wave, high temperature stress, cold wave and frost etc. The districts identified along with their climate vulnerability are depicted in the map below:



Map showing 121 implementation sites and climate vulnerabilities.
Figures in parentheses are the number of districts addressing the vulnerability.

To address the climate vulnerabilities of the district, NICRA-KVKs selected one representative village cluster for project implementation. Participatory rural appraisal (PRA) and focus group discussions (FGD) were undertaken along with a survey at household level. A baseline was established, constraints were flagged and an action plan prepared in consultation with the farmers and the innovative village climate risk management committee (VCRMC) created in the project to enable participatory decision making and empowerment. A holistic and integrated action plan was implemented in four modules with location-specific interventions aimed at development of climate resilient villages. Prioritization of interventions is based on extent of exposure to climate vulnerability of the different farming situations prevalent in the village and takes into account building resilience of different categories of farmers and communities.

The specific objectives of technology demonstration component are:

- To demonstrate site specific technology interventions on farmers fields for coping with climate variability in vulnerable districts.
- To generate awareness and build capacity of farmers and other stakeholders on climate resilient agriculture
- To evolve innovative institutional mechanisms at village level that enable the communities to respond to climate stresses
- To foster evidence based planning and mainstreaming of climate resilient practices and technologies through various public funded programs/schemes

Rationale for interventions

Climate resilient agriculture is an approach to ensure food security, build resilience of agricultural systems and adaptive capacities of farming communities to climate change and variability. Farmers in NICRA villages are encouraged to apply proven practices and technologies to climate induced problems in agriculture. Interventions with climate focus are accorded priority and are sourced from the National Agricultural Research System (NARS), indigenous technical knowledge and traditional knowledge of communities. Innovative practices, processes, products, decision tools and livelihood options appropriate to the farming situations are encouraged to tackle climate risks in agriculture.

Technology Modules

Interventions for climate resilience are implemented in four modules:

Module I: Natural Resource Management

This module consists of interventions related to *in-situ* moisture conservation, rainwater harvesting and recycling for supplemental irrigation, improved drainage in flood prone areas, conservation tillage where appropriate, ground water recharge and water saving irrigation methods, mulching, crop residue recycling, land and soil health management.

Module II: Crop Production Systems

This module comprises of introduction of stress tolerant crops, resilient cropping systems, stress tolerant cultivars to drought, flood, high temperature, cold stress, pest and diseases; contingency crop planning, crop diversification, water saving paddy cultivation methods (SRI, aerobic, direct seeding), staggered community nursery technique for paddy transplanting in delayed monsoon / deficit rainfall conditions, advancement of planting dates of *rabi* crops in areas facing terminal heat stress and frost, site specific nutrient management, Integrated pest, disease and crop management.

Module III: Livestock and Fisheries Production Systems

In this module interventions include introduction of stress tolerant breeds, improved feed and mineral supplementation, fodder production, silage making, preventive vaccination, improved shelters for reducing heat stress in livestock, innovative fish production systems.

Module IV: Institutional Interventions

Enabling support systems in the village include strengthening of existing institutions or initiating new ones (Village Climate Risk Management Committee, VCRMC), establishment and management of custom hiring centre for farm implements, seed bank, fodder bank; creation of commodity groups, initiating collective marketing by tapping value chains; introduction of weather index based insurance and climate information & advisory services using data from automatic weather station & village level manual weather station.

2. Rainfall Analysis

Several NICRA project sites experienced deficit rainfall situations in 2014 during the South West Monsoon season (Table 2) and deficit rainfall conditions prevailed in different months between June to September (Table 3), which adversely affected the sowings and crop performance especially of soybean, cotton, groundnut, short duration pulses, rice, maize, millets (sorghum and pearl millet) in rainfed states and districts.

Table 2: Deficit seasonal rainfall in NICRA sites

State	District	Actual (mm)	Normal (mm)	Deficit over normal (mm)	Departure from normal (%)
Andhra Pradesh	Anantapur	159	338	-179	-53
	West Godavari	560	748	-188	-25
Bihar	Buxar	376	861	-485	-56
	Saran	499	974	-475	-49
	Jehanabad	439	820	-381	-46
Chhattisgarh	Bilaspur	600	1068	-468	-44
Gujarat	Valsad	1138	1951	-814	-42
Jharkhand	Palamu	353	975	-622	-64
	Chatra	558	1031	-474	-46
	Koderma	684	1026	-342	-33
	Gumla	845	988	-143	-15
Karnataka	Chickballapur	195	412	-217	-53
	Belgaum	400	574	-175	-30
Madhya Pradesh	Chhatarpur	330	985	-655	-66
	Satna	576	953	-377	-40
	Datia	516	759	-243	-32
	Guna	782	943	-161	-17
Maharashtra	Ahmednagar	213	438	-225	-51
	Pune	639	861	-222	-26
	Amaravathi	745	787	-41	-5
	Buldhana	626	647	-21	-3
Manipur	Imphal East	727	1164	-437	-38
	Senapati	819	1281	-462	-36

State	District	Actual (mm)	Normal (mm)	Deficit over normal (mm)	Departure from normal (%)
Mizoram	Lunglei	1110	1866	-757	-41
Nagaland	Mokokchung	730	1676	-946	-56
	Phek	685	1308	-624	-48
Odisha	Sonepur	758	1243	-485	-39
Punjab	Faridkot	204	325	-121	-37
Rajasthan	Bharatpur	429	558	-129	-23
Tamil nadu	Ramanathapuram	100	149	-50	-33
Telangana	Nalgonda	218	633	-415	-66
	Khammam	622	866	-244	-28
Tripura	West Tripura	873	1396	-523	-37
Uttar Pradesh	Gorakhpur	365	1176	-811	-69
	Jhansi	462	838	-376	-45
	Baghpat	357	545	-188	-34
	Kushinagar	883	1158	-275	-24
	Gonda	766	943	-177	-19
	Sonebhadra	804	917	-113	-12
Uttarakhand	Uttarkashi	664	1149	-485	-42

Table 3: Departure in monthly rainfall at NICRA sites

State	District	Departure from normal (%)			
		June	July	August	September
Andhra Pradesh	Ananthapur	-34	-58	-40	-69
	West Godavari	-89	-29	-26	23
Bihar	Buxar	-94	-	-	-76
	Saran	23	-58	9	2
Chhatisgarh	Bilaspur	16	-60	-87	6
Gujarat	Valasad	-13	-39	-58	-54
Jharkhand	Chatra	125	-40	-	-
	Gumla	-48	-92	-25	-30
	Koderma	-58	2	-22	-85
	Palamau	-46	-54	-64	-87

State	District	Departure from normal (%)			
		June	July	August	September
Karnataka	Belgaum	8	-53	-36	-63
	Chickballapur	-32	-82	29	-
Madhya Pradesh	Chhatarpur	-9	-69	-78	-69
	Satna	9	2	-66	-89
	Datia	-61	-17	-41	-21
	Guna	-55	-36	18	-35
Bihar	Jehanabad	-66	-44	-8	-89
Maharashtra	Ahmednagar	-41	-17	40	-83
	Amaravathi	-7	-33	4	17
	Buldhana	-19	16	-13	1
	Pune	3	-33	-15	-55
Manipur	Imphal east	-58	-29	-9	-55
	Senapati	-11	-61	-34	-40
Mizoram	Lunglei	-85	-47	-46	24
Nagaland	Mokokchung	-60	-69	-77	15
	Phek	-16	-74	-49	-46
Odisha	Sonepur	-25	-14	-47	5
Punjab	Faridkot	78	0	-89	-85
Rajasthan	Bharathpur	106	-41	-42	-59
Telangana	Khammam	-83	-16	-55	38
	Nalgonda	-71	-80	-37	-81
Tripura	West Tripura	-30	-35	-57	-28
Uttar Pradesh	Gorakhpur	24	-63	-	-
	Jhansi	-29	-37	-74	-12
	Baghpat	221	-71	-64	-6
	Gonda	9	-1	-13	-69
	Kushinagar	54	-89	20	-50
	Sonbhadra	-62	12	17	-56
Uttarakhand	Uttarkashi	-18	-13	-49	-

3. Highlights of Technology Demonstrations in 2014-15

3.1. Natural Resource Management

Enhancing the available water through surface and sub-surface storage structures is one of means of creating resilience at the local level for agricultural systems. This form of infrastructure development plays much more important role in low to medium rainfall zones as rainfall variability and occurrence of intense rainy events are considered to be high.

Realizing the importance of this activity, farmers in NICRA villages adopted a multi-pronged approach including the creation/renovation of community tanks, check dams, desiltation of conveyance systems for safe disposal of excess rain into community tanks, individual farm ponds, and *in-situ* conservation of rainfall through soil and land management practices. Village climate risk management committees (VCRMCs) in NICRA villages played an important role in the participatory decision making on the site specific natural management interventions to be taken up in the village.

Rainwater harvesting (*ex-situ*) and efficient use to enhance resilience of farms

In Nacharam village of Khammam, farm ponds brought about a perceptible change in crop production during *Kharif* season. Though the rainfall was less (6 rainy days) during months of June and early part of July, the intense storms of 39.3 mm and 34.8 mm generated runoff and was stored in farm ponds created in farmers field. The harvested water was used for critical irrigations to cotton, chilies and fodder grass. Farmers realized an additional yield and income from cotton (250 kg/ha, Rs.10500), chilies (150 kg/ha, Rs.9000) and fodder grass (4 t/ha, Rs.10900).

Two critical irrigations using harvested water from farm pond saves cotton in Khammam, Telangana

In Harigaon village, Aurangabad, rainwater storage capacity of 12700 cubic meters was created through 9 ponds in 9 farmers' fields during 2014-15. The harvested water was used to irrigate 9.3 ha area for improving yield in lentil (11.2 q/ha), chickpea (9.0 q/ha) and wheat (40.0 q/ha). Irrigated area increased by 69% due to increase in water use efficiency.

Rainwater harvesting and efficient utilization through drip to chickpea crop in Aurangabad, Maharashtra

In Boroundi village of Datia, rainwater storage capacity of 18000 and 51000 cubic meter was created through renovation of 3 farm ponds and 3 check dams during 2014-15. It brought about crop diversification, facilitated life saving irrigation to *kharif* crops and increased cropping intensity in *rabi* crops. Efficient use of farm pond water through sprinklers and rain gun in *kharif* and *rabi* crops increased the net returns and doubled the cropping intensity. Pre-sowing irrigation through micro irrigation to mustard using harvested water practiced by 118 farmers in 128 ha, which resulted in an average yield of 16.3 q/ha and net returns of Rs.36800 with a BC ratio of 3.2. The harvested water was available up to December month and raised the water level of 28 wells. Additionally, 15 ha area could be irrigated through wells. Cultivation of high value crops such as tomato, chilies, brinjal and cauliflower through farm ponds and check dam along with micro irrigation enhanced yields and additional income ranging from Rs.79000/ha to Rs.148000/ha with BC ratio ranging between 4.2 - 5.6.


Rainwater harvesting promotes crop diversification and enhances productivity at Boroundi village of Datia, MP

In Khargahna village of Bilaspur, pre-sowing irrigation in wheat (GW-273) using harvested rainwater in renovated community tank taken up by 50 farmers in 20 ha resulted in higher productivity (22 q/ha) with net returns of Rs.18500 and BC ratio of 2.9. The harvested water was available up to March and irrigated area increased by 20 ha during *rabi*.

Good crop stand due to pre sowing irrigation with harvested water at Bilaspur, Chhattisgarh

In Hirehalli village of Tumkur, despite higher rainfall during 2014-15 in June (by 54%) July (66%) and September (86%) compared to the previous year, farmers still had to cope with intermittent dry spells during crop growth period. Seven farmers constructed farm ponds during 2014-15. These adds to the tally of 73 farm ponds constructed since inception in the village with a potential storage capacity of 18000 cubic meters benefitting 85 farmers with an irrigation potential of 16 ha during *rabi* 2014-15. Sri Kemparaju utilized harvested rainwater from his farm pond (40 x 12 x 3 m, 1440 cu. m.) to increase the cropping intensity through raising of high value vegetable crops (carrot and tomato) and flower crop (aster) in one acre area after *kharif* (Table 4). This practice enhanced the profitability from his land parcel from Rs.14000 by cultivating groundnut and finger millet during *kharif* season with an additional return of Rs.53400 from *rabi* season.

Table 4: Cropping intensity increase in rainfed situation with harvesting of rainwater

Crop	Area (acre)	Yield	Cost (Rs.)	Gross income (Rs.)	Net income (Rs.)	B:C ratio
Aster	0.4	8.5 q	6100	20400	14300	3.3
Tomato	0.4	1.7 t	5850	25500	19650	4.3
Carrot	0.2	1.2 t	4550	24000	19450	5.3

Farmer increased cropping intensity and returns from high value crops using harvested rainwater at Tumkur, Karnataka

In Vadavathur village of Namakkal, 3 community ponds were desilted and renovated for rainwater harvesting which helped in recharging of 12 open wells and 18 tube wells. This intervention helped in successfully cultivating onion (166 q/ha), groundnut (17 q/ha), sorghum (24q/ha), ridge gourd (138 q/ha) and jasmine (37.5 q/ha) crops in 26 ha area despite the deficit rainfall conditions experienced during 2014-15.

Renovation of check dam increases water table and storage in open wells for irrigating rabi crops at Amravati, Maharashtra

In Takali (BK) village of Amravati district, renovation of 13 cement plugs and 7 farm ponds of different water storage capacity was undertaken by farmers in 2014 and this helped in recharging the surrounding open wells. Desilting of these structures increased percolation of impounded water leading to increase in water table by 2.5’ to 4.3’, water availability for irrigation by 13% and area increased by 17% during 2014-15. Renovation of rainwater harvesting structures since inception of the NICRA project could expand the area under irrigation in the village during *rabi* to 120 ha.

Community storage tank in Vadavathur village, Namakkal, Tamilnadu helps farmers to take up high value crops

In Jalgaon KP village of Baramati, rainwater harvesting and recharging of wells facilitated supplemental irrigation to *rabi* sorghum in 18 ha area. A cement bandhara was constructed during 2014-15 which impounded sufficient water to recharge 6 adjoining wells. Monitoring indicated rise in water level (Table 5) leading to increased water storage and availability for two supplemental irrigations to *rabi* sorghum resulting in 38% increase in productivity (23.7 q/ha). Similarly, 2-4 protective irrigations were given to pearl millet, wheat and onion with increase in productivity by 20-30%.

Table 5: Monitoring of water level in open wells adjoining cement bandhara in Jalgaon KP village, Pune, Maharashtra

Month	RF (mm)	Increase in water level (ft)	Area irrigated (ha)
Jun	40.2	7.6	13.2
July	59.4	12.5	18.0
Aug	190.6	7.5	9.0
Sep	2	8.25	17.2

Recharging of open wells enhances rabi sorghum productivity at Baramati, Maharashtra

In East Singhbhum, monsoon onset was delayed by 10 days with deficit rainfall conditions in June (-51%) and September (-39%) which affected timely raising of paddy nurseries in the district. In the NICRA villages of Barunia and Pathergora, farmers with their fields adjoining the renovated check dam could prepare paddy nursery (var. Naveen) by 15th June and transplant in the main fields by first week of July compared to other farmers who could transplant only by 18th July. Farmers were able to provide critical irrigations to the crop in 15 ha area during dry spells in August (tillering stage), September (panicle initiation and flowering) and November to December (maturity stage) and realized an yield advantage of 17 q/ha.

Renovated check dam facilitates timely nursery and transplanting of paddy in East Singhbhum, Jharkhand

In Bhalot village of Kutch, farmers face erratic and scanty rainfall. The village received 375 mm rainfall during 2014-15 season, which was 145 mm less than the decadal average. However, farmers with recharged open wells adjoining 3 stop dams constructed in the village could take up timely sowing of Bt cotton under drip irrigation with an yield increase of 26%. Seeing the success of recharged open wells coupled with efficient use through drip irrigation, 82 farmers in the village adopted the practice in 108 ha area which is significant increase from adoption by 12 farmers in 13 ha area in the first year.

Recharging of open wells enables timely planting of Bt Cotton under drip irrigation at Kutch, Gujarat

In Chopara village of Ganjam, a check dam was constructed with the help of villagers in the old seasonal canal having an area of 50m x 15m x 3m which increased irrigation area by 6 ha. During 2014-15, monsoon delay of 2 weeks coupled with 60 % shortfall in rainfall up to 1st week of July hampered normal sowing of paddy in the nursery. Farmer was able to complete transplanting of paddy (Pratiksha) by 4th week of July in fields near check dam. Farmer utilized check dam water for transplanting and life saving irrigation during dry spells increased yield by 12%.

In Sitara village, Bharatpur, poor quality of groundwater due to salinity is a problem faced by farmers responsible for low productivity in *rabi* crops. Hence, recharging of all the 54 tube wells was targeted and undertaken in a phased manner in the village. During 2014-15, impact of recharging of 10 tube wells was monitored in farmers fields by selecting 5 ha area under wheat. Salinity of groundwater was monitored during each of the four-five irrigations that were applied to the wheat crop. Recharging of wells helped in providing better quality irrigation water at early crop growth stages (germination and tillering) as the salinity increased from 5.8 - 9.7 EC (ds/m) at first irrigation to 8.9 - 16.5 EC (ds/m) at last irrigation. As a result farmers were able to realize 18% higher yields (45-54 q/ha) compared to farmers in the nearby village (36 - 48 q/ha).

Recharging of tube wells helps in decreasing salinity of groundwater for early irrigations in wheat at Bharatpur, Rajasthan

Farmers of Nandyalagudem village in Nalgonda faced deficit rainfall conditions during *kharif*, 2014-15 which severely affected cotton and other rainfed crops in red soils. Seasonal rainfall of 351 mm was received. Farmers with irrigation sources adopted drip irrigation for their cotton crop which was extensively cultivated in the village. Shri Venkat Reddy, farmer gave four supplemental irrigations to cotton through drip during prolonged dry spells in September and October and realized yield advantage of 10 q/ha compared to poor performance of cotton in rainfed situation under deficit rainfall conditions.

Drip irrigation from recharged tube well saves cotton in Nalgonda district

Rainwater harvesting a boon to farmers in hilly regions

In Chhoel-gadouri village of Kullu, demonstrations were conducted on cultivation of tomato in rainfed area by providing life saving irrigations during dry spells from the stored water in small community water storage tanks of 200 cubic meter capacity was constructed in the village. During the year 2014, demonstration on tomato cultivation was conducted in 20 farmers' fields covering an area of 2.2 ha. The stored water could be used to provide 5 supplemental irrigations during the season. Farmers in this village traditionally cultivate only summer maize. Rainwater storage and use, enhanced the net income of farmers by providing additional net returns from the high value crop with a BC ratio of 3.8.

Community water storage tanks facilitate cultivation of high value crops at Kullu, HP

In Chamba, Lagga village, two old non-functional water bodies were renovated during the summer of 2014. Water from this was carried to a newly constructed water storage tank (60 cubic meters). Availability of irrigation water was increased during the critical stages of crop growth which was utilized for raising vegetable crops like cabbage and cauliflower. During 2014-15, eight farmers utilized this opportunity in 1.8 ha additional area which was brought under high value vegetable crops.

Community water storage tanks facilitate cultivation of
high value crops at Chamba, HP

In West Garo Hills, interventions were taken up to popularize low cost rainwater harvesting in Jalkunds (5 x 4 x 1.5 m) of 30000 liters storage capacity with silpaulin or grass lining material. Harvested rainwater during rainy season was used for critical irrigation during subsequent dry spells in winter vegetable crops (cabbage, cauliflower and tomato). Twelve farmers constructed Jalkunds and cultivated winter vegetables in 4.1 ha and realized a total net income of Rs. 1,83,937 with a benefit cost ratio of 3.1.

Jalkund promotes cultivation of winter vegetables in West Garo Hills, Meghalaya

Shri Tashi Lepcha of Nandok village in East Sikkim, constructed a Jalkund on the upper part of the field for conserving the runoff rainwater during rainy season by digging a pit of 5 x 4 x 1.5 m and covered with a plastic lining of 250 GSM with a potential storage of 30 cubic meter of rainwater. The harvested water was utilized by 4 farmers in 1.8 ha area as life saving irrigation through micro irrigation for sole crops, vegetable seedlings and potato. Judicious use of Jalkund water to irrigate rabi crops during dry spells with sprinklers made vegetable production a profitable venture. The low cost ponds helped in doubling the cropping intensity with net returns of Rs.100320 (Table 6).

Table 6: Rainwater harvesting increased cropping intensity and income in Nandok village, East Sikkim

Crops	Production (kg)	Gross cost (Rs.)	Gross income (Rs.)	Net income (Rs.)	B:C ratio
Cabbage	4670	18750	46700	29850	2.5
Cauliflower	1430	9200	21450	12250	2.3
Broccoli	980	8560	19600	11040	2.3
Vegetable pea	540	3270	10800	7530	3.3
Vegetable seedlings	58,600 seedlings	19650	58600	39650	3.0
Total		58630	158950	100320	

Jalkund enhances income of farmers from winter vegetable cultivation in East Sikkim, Sikkim

In Udmari village of Dhubri district of Assam, renovation of drainage channel (900 m, 10-14' width and 4-7' depth) which was connected to the river Gaurang led to reduction in flood-prone area by 500 ha due to quick removal of excess water during kharif season. Summer and early Ahu rice crops which usually suffered 20-50% loss from submergence from recurrent flooding due to heavy rain during pre-monsoon period have now been protected after the intervention.

Improving drainage for removal of excess rainwater in kharif reduces submergence of paddy in Dhubri, Assam

Table 7: Summary of NRM interventions across districts in 2014-15

Structure	State	Districts	Crop	No. of farmer	Area (ha)
Farm pond	Bihar	Aurangabad	Wheat, Lentil, Gram	9	9.3
	Bihar	Nawadah	Wheat and potato	40	10
	Bihar	Jehanabad	Wheat (HD-2733), Gram (Pusa-256) & Lentil (Arun)	20	9
	Uttar Pradesh	Uttarkashi	Vegetables	14	14
	Jharkhand	Gumla	Wheat and vegetables	5	8
	Jharkhand	Cooch Behar	Wheat and Potato	2	6
	Chhattisgarh	Bilaspur	Wheat (GW-273)	50	20
	Jharkhand	East Singhubhum	Mustard, Linseed, Wheat and Vegetable	3	20
	Manipur	Imphal East	Vegetables	1	1
	Telangana	Khammam	Fodder grass, Chilli	4	3
	Rajasthan	Kota	Mustard	1	2

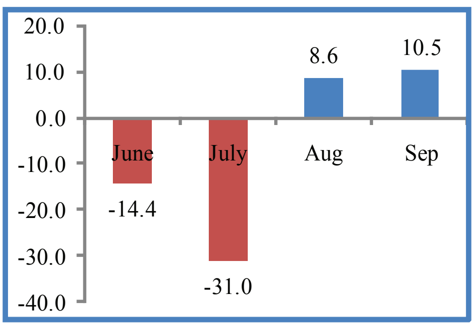
Structure	State	Districts	Crop	No. of farmer	Area (ha)
	Madhya Pradesh	Datia	Wheat, Mustard	3	12
	Odisha	Ganjam	Paddy, tomato	13	8
	Karnataka	Davanagere	Maize, vegetables	15	5
	Karnataka	Tumkur	Tomato, Aster	9	5
	Madhya Pradesh	Guna	Soybean	14	4.5
Jalkund	Meghalaya	Ri Bhoi	Vegetables	10	2.8
	Meghalaya	West garo hills	Vegetables	2	2
	Nagaland	Dimapur	Vegetable	5	1
	Sikkim	East Sikkim	Vegetables	30	4
Check dam	Chhattisgarh	Dantewada	Paddy, Pulses and Vegetables	44	18
	Bihar	Jehanabad	Wheat , Gram, lentil	120	42
	Jharkhand	East Singhubhum	Paddy, Wheat, Mustard, Vegetable	5	20
	Gujarat	Kutch	Cotton and Castor	73	153
	Gujarat	Rajkot	Groundnut and wheat	27	43
	Karnataka	Tumkur	Paddy	5	2
	Odisha	Ganjam	Paddy, tomato	18	5
Sand bag check dam	Jharkhand	Gumla	Wheat and vegetables	55	22
	Telangana	Khammam	Paddy	36	10
	Maharashtra	Nandurbar	Soybean	12	5
	Gujarat	Valsad	Paddy, Cotton	25	15
	Madhya Pradesh	Balaghat	Wheat, Tomato, Brinjal	45	37
	Madhya Pradesh	Datia	Mustard, Tomato, Chilli, Brinjal, Cauliflower	55	65

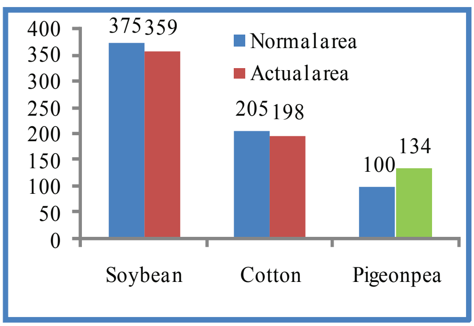
Structure	State	Districts	Crop	No. of farmer	Area (ha)
Drainage channel	Bihar	Saran	Paddy	23	6
	Bihar	Aurangabad	Paddy, Wheat	110	-
	Assam	Dubri	Paddy	-	512
	Assam	Sonitpur	Paddy	12	4
	Andhra Pradesh	Srikakulam	Paddy	70	10
	Karnataka	Belagavi	-	127	-
Percolation tank	Andhra Pradesh	Anantpur	-	10	8.8
	Madhya Pradesh	Guna	Soybean	14	4.5
	Madhya Pradesh	Morena	Wheat and Pearl millet	55	12
Well recharge	Rajasthan	Bharatpur	Wheat	10	10
	Uttar Pradesh	Chitrakoot	Chick pea	11	15
	Andhra Pradesh	Kurnool	Wheat- PDKV Washim (WSM-1472)	10	10
	Maharashtra	Amravati	Soybean -9305 & Chickpea-jacki-9218-02	25	10
	Maharashtra	Amravati	Cotton Bt 3028	25	10
	Telangana	Nalgonda	Cotton and Chilli	10	4
	Tamilnadu	Villupuram	Flower crops	35	8
Community Tank	Himachal Pradesh	Kullu	Tomato	20	2.2
	Himachal Pradesh	Chamba	Cabbage and Cauliflower	8	2
	Bihar	Saran	Paddy, Wheat and Vegetables	93	26.56
	Tamilnadu	Namakkal	*Rabi* crops, Vegetables and flower crop	134	123

Improved planting methods for *in-situ* soil moisture conservation

In-situ rainwater management through ridge and furrow method and broad bed furrow practice conserves rainwater at field level and also drains out excess water into community drainage channels. This water can also be utilized for recharging ground water to provide supplemental irrigation to post-rainy season crops, which is otherwise not possible with flat bed planting. Through these methods, soil moisture is managed by maximizing the use of rainfall through increased infiltration and moisture retention and reducing runoff and soil erosion. The performance of high yielding improved varieties is optimized by *in situ* moisture management. Surface runoff and deep drainage water is exploited as supplemental irrigation to post-rainy season crops like wheat and chickpea. The same helps to drain out the excess water from the field to save the crop from water logging condition also. Improved planting methods were promoted in NICRA villages for cultivation of different crops in Maharashtra, Madhya Pradesh, Uttar Pradesh, Rajasthan, Odisha, West Bengal, Karnataka and Jharkhand.

In Takali village of Amravati, due to delayed onset of monsoon and deficit rainfall conditions in July (-31%) farmers decreased area under soybean and cotton (by 5%) and opted for increased area under pigeonpea (34%). Farmers adopted *in situ* moisture conservation practices and contingency measures to cope with the aberrant rainfall conditions. In cotton, ridge furrow planting was adopted by 103 farmers in 285 ha with an yield advantage of 15% over the farmers practice. In soybean, broad bed furrow planting, ridge furrow planting and sowing across the slope along with adoption of short duration variety (JS-93-05, 90 days) resulted in an yield advantage of 22% over farmers practice of long duration variety without *in situ* conservation measures.





Farmers respond by increasing area under pigeonpea due to deficit rainfall in June-July in Takali village of Amravati, Maharashtra

In-situ conservation practices in soybean and cotton in Takali village of Amravati, Maharashtra

In Bhargawan village of Satna, *in situ* soil moisture conservation practice through ridge and furrow planting in blackgram, greengram and soybean resulted in an yield of 5.2, 6.3 and 12.5 q/ha, respectively despite prolonged dry spells during the season. Similarly, ridge and furrow planting of soybean in Sanora village of Datia district by 20 farmers in 8 ha gave an yield of 11.2 q/ha compared to 7.8 q/ha in conventional practice.

Ridge & furrow planting of soybean at Datia, MP

In Shikhera village of Baghpat, demonstration of mustard (PUSA M-27) in *rabi* season in raised bed planting facilitated increase in water productivity and increase in yields by 20% over conventional practice (14.8 q/ha) with BC ratio of 3.4.

In Chomakot village of Kota district, farmers face erratic rainfall with long dry spells affecting soybean in *kharif* and wheat in *rabi* due to water shortages. Furrow irrigated raised bed (FIRB) planting in soybean resulted in an yield increase of 6% compared to conventional sowing (9.6 q/ha). FIRB technique in wheat led to increase in productivity by 4% over conventional practice (41 q/ha) along with water saving of 22-25%, saving in seed requirement with BC ratio of 2.7. The wheat crop planted in FIRBs suffered less damage due to unseasonal rains and hail storm during March, 2015.

FIRB planting of soybean
at Kota, Rajasthan

FIRB planting of wheat
at Kota, Rajasthan

In Umarani village of Nandurbar district, generally, farmers sow the crop behind the plough along the slope resulting in increase in runoff and erosion of soil from agricultural fields. Ridge furrow planting across the slope using short duration maize cultivar (GM-6) at closer planting (45 x 15 cm) by 13 farmers resulted in yield increase of 13% (20.4 q/ha) compared to farmers practice (18.1 q/ha).

In Bhoimunda village of Jharsuguda farmers practiced ridge furrow planting in cowpea and radish resulting in increased yield due to improved conservation of soil moisture. In cowpea, 18% yield advantage was obtained compared to farmers practice (52.3 q/ha) and in radish, the yield advantage was 15.8% compared to the farmers practice (127 q/ha) with BC ratios ranging between 4.4 to 4.7.

Ridge & furrow planting of maize at Nandurbar, Maharashtra

Ridge & furrow planting of cowpea at Jharsuguda, Odisha

In Sarkho village of Guna, soybean crop experiences moisture stress during long dry spells and also suffers terminal moisture stress due to early withdrawal of monsoon. Ridge furrow planting of short duration soybean (JS-95-60) not only facilitates *in-situ* moisture conservation but also drainage of excess water in black soils and resulted in increased crop yield by 23% compared to farmers practice (15.9 q/ha). At 45 days after sowing, soil moisture percentage was higher by 34% in ridge furrow system compared to flat sowing which resulted in higher rainwater use efficiency (2.14 kg/ha/mm).

Ridge & furrow planting of short duration soybean (JS-95-60) at Guna, MP

In Nidhan and Jeghani villages of Morena, pulse crops are mostly affected due to uncertain rainfall and water logging in case of excess rainfall. Bed planting of blackgram (PU-35) and greengram (TJM-3) performed better in 2014-15 with increase in crop yields by 2 q/ha.

Broad bed furrow planting of blackgram (PU-35) at Morena, MP

In Jalgaon, KP village of Baramati, adoption of compartmental bunding (10 m × 10 m) in *kharif* fallows prepared across the slope in medium black soils in 20 ha area by 50 farmers led to conservation of soil moisture and successful raising of *rabi* sorghum with increased productivity of 19.5 q/ha compared to 11.5 q/ha without the intervention.

Field demonstration of compartmental bunding across the slope

Effect of bunding in rabi sorghum

In Chainith village of Buxar, rising of bund height (60x45x45 cm) around the rice field was adopted by 8 farmers in 4 ha area which resulted in yield of 53 q/ha compared to 45 q/ha in farmer's practice despite reducing number of irrigations from six to four.

In Khagribari village of Cooch Behar, raised bed cultivation of cucumber with plastic mulch gave higher yield (291 q/ha) compared to flat bed cultivation (262 q/ha) due to improvement in flower retention by 10%, advancement in fruit set by 5 days and lengthening of fruiting period by 20 days due to favourable soil moisture and temperature conditions.

Cucumber in raised beds with plastic mulch saves water and increases productivity at Cooch Behar, West Bengal

In Tirap, to overcome the drought like situation in the NICRA village Sipini, 23 farmers adopted broccoli cultivation with plastic mulching and realized higher yield (150 q/ha) and net returns of Rs. 282980/ha with a BC ratio of 4.1 compared to cultivation without plastic mulching (116 q/ha, Rs.150725/ha, BC ratio of 2.9).

In North Pulinpur ADC village of West Tripura, furrow irrigated raised bed maize cultivation was demonstrated in 17 farmer' fields in an area of 3.5 ha. In FIRB method, maize hybrid (Disha-3502) was sown adopting a spacing of 37.5 cm wide beds and 30 cm wide furrow compared to the farmer's practice of line sowing in flat land at a row spacing of 67.5 cm. Life saving irrigation was provided from the water harvesting structure constructed under NICRA. FIRB method gave an yield advantage of 8 quintal with a BC ratio of 3.0 compared to flat bed method of sowing (33 q/ha, BC ratio of 2.6).

FIRB method in maize at West Tripura, Tripura

Table 8: Summary of planting methods adopted by farmers across districts

District	Crop	Cultivars	Intervention	No. of demon-strations	Area (ha)
Ahmednagar, Amravati, Nandurbar, Aurngabad, Baramati	Soybean, Cotton, Maize, *rabi* sorghum	JS-9305, Ajeet 155, GM-6, MAUS-71, Maldandi	Ridge & furrow, Bed planting, Compartmental bunding	660	509
Hamirpur, Gonda	vegetable pea Pigeonpea	Azad pea-3 NA-1	Ridge and furrow	48	6.4
Datia, Morena, Satna, Guna	Soybean, Greemgram, Blackgram, Maize	JS-95-60 TJM-3, PU-35, NK-6240, Smrat	Ridge and furrow	106	31
Dhubri	Maize	SMH 36	Ridge and furrow	6	1
Coochbehar	Cucumber	Barsati	Ridge and furrow	11	0.9
Kendrapara	Sugarcane, Potato	Raghunath, Kufri Chandramukhi	Ridge and furrow	15	3
Hamirpur	Bitter Gourd, Cucumber Summer Suqash Bottle Gourd Cucurbits Cauliflower Cabbage	Palee, Aman Malav Australian Green Aman Pali 626 Green Voyagr	Ridge and furrow	52	4.6
Villupuram	Snake gourd Bitter gourd	PLR 2, CO 1	Broad bed furrow	20	2

Zero till cultivation in plains

Sowing of *rabi* crops depends on the harvesting time of the preceding crop in *kharif* and also soil moisture status for undertaking land preparation for sowing. In case of wheat, this involves 2 to 3 or even more tillage operations for obtaining appropriate tilth before planting of wheat. In addition to the costs incurred and energy required, this causes delay in planting of wheat which often results in coincidence of vulnerable stage with high temperature stress during February/ March. This often leads to reduction in grain yield and loss to farmer. Zero till technology offers a viable and practical solution by avoiding repeated tillage for land preparation and sowing, reducing cost of cultivation and also permits planting early by 10-15 days. Advancement in sowing date is an adaptation to avoid terminal heat stress. Zero-tillage refers to direct drilling of wheat in unploughed paddy fields immediately after rice harvest using zero till drill or happy seeder. This practice is a sustainable alternative to conventional planting of wheat in the rice-wheat cropping system areas of Punjab, Haryana and U.P. Multiple advantages include saving in fuel, water and reduction in greenhouse gas emissions apart from recycling of crop residues instead of burning and minimizing environmental hazards.

In Punjab, mechanical harvesting of rice and wheat has given rise to the problem of residue management. In areas where combine harvesters are used for harvesting of rice, happy seeder sowing of wheat in rice residue (standing or lose residue) was demonstrated in NICRA villages. In areas where manual harvesting of rice is practiced, wheat is sown with zero till drill. Both the practices have shown promise in terms of saving in labour costs, water and advancement in planting date to escape terminal heat stress.

In Killi Nihal Singh village of Bathinda, demonstration of wheat (HD-2967) with happy seeder resulted in 3% increase in yield at 50.4 q/ha compared to conventional practice and allowed incorporation of paddy straw into the soil improving soil moisture retention and infiltration of excess water due to unseasonal rains.


Wheat sown with happy seeder at Bathinda, Punjab

In Badhouchhi Kalan village of Fatehgarh Sahib burning of paddy stubbles is generally practiced by farmers which causes environmental pollution along with nutrient loss. Demonstration of wheat (HD 2967) sowing with happy seeder in 19 farmers' field in 16 ha area during 2014-15 provided an alternative for rice residue management and resulted in an increase in yield by 11.6% compared to conventional tillage practice (38 q/ha).

In Pindi Balochan village of Faridkot, demonstration of timely sowing of wheat (PBW 2967) with zero till drill in 30 farmers' field covering 36 ha area in 2014-15 gave 46 q/ha yield with increase in farmers income by Rs. 2055/ha.

In Rasidpur village of Ropar, use of happy seeder for wheat (HD 2967) sowing was demonstrated in 12 farmers fields in 16 ha area with an yield advantage of 13.6% over farmers practice of conventional tillage (44.8 q/ha). Further, crop lodging damage due to unseasonal rainfall during March, 2015 was lower in happy seeder sown wheat which was only 2% compared to 15-20% in conventionally sown wheat. In addition, incidence of yellow rust was more in lodged crop than in happy seeder sown wheat.

In Radauri village of Yamunanagar, happy seeder sown wheat (HD 2967) in 33 ha area involving 84 farmers gave 9% higher yield on an average compared to conventional tillage sown wheat (46.3 q/ha).

In Seorahi village of Kushinagar, zero till sown wheat (HD 2733) in 20 ha covering 97 farmers gave an yield advantage of 21% compared to farmers practice (42.3 q/ha). Reduction in cost of cultivation was Rs.6255/ha along with saving of 15% irrigation water and facilitating early sowing by 10-15 days to reduce exposure to terminal heat stress.

In Jhangha village of Gorakhpur, wheat (WL-711) was sown directly after harvest of rice using zero till seed drill in 6 ha involving 30 farmers with a mean yield of 35.5 q/ha during 2014-15 season.

Lodging in wheat crop in farmer practice at Gorakhpur, UP

Zero till wheat - No lodging at Gorakhpur, UP

In Nidhan village of Morena, wheat is taken up after short duration pigeonpea. Zero till sowing of wheat is a key adaptation in this system to avoid terminal heat stress at susceptible growth stage. The practice was adopted by 25 farmers in 50 ha area with a mean yield of 50.2 q/ha compared to 48.1 q/ha without the intervention.

Direct seeded rice (DSR) technology saves expenses related to nursery raising but also field preparation and saving of irrigation water required for puddling prior to transplanting of seedlings. About 3-4 irrigations/ha were saved with direct seeding of short duration paddy variety (Pusa Basmati 1509) by farmers in Mumtajpur village adopted by IARI. Similarly, the farmers uptake of zero-tillage in wheat was mostly due to savings in labour, water and energy.

Direct Seeded Rice demonstration in Mumtajpur village by IARI

In Harigaon village of Aurangabad, Bihar, zero till sowing of paddy (Rajendra Sweta) in 4 ha area by 11 farmers gave a mean yield of 34.5 q/ha compared to farmers practice of transplanting (30 q/ha) with a BC ratio of 1.92.

In Sirsuwada village of Srikaulam, rice-rice and rice-pulse cropping systems are practiced. Blackgram taken up in paddy fallows suffers from yellow mosaic virus disease and exposure to low temperature and fog at the time of flowering resulting in low yields. Maize is a possible alternative after rice. Zero till maize was adopted by 15 farmers in 5 ha area to conserve residual soil moisture, save 1-2 irrigations and also to reduce cost of dibbling seed and cost of land preparation.

Zero till maize in rice fallows at Srikakulam, AP

Sustainable intensification in rice fallows in the hilly regions

Prior to intervention of NICRA, farmers leave fields fallow after rice harvest. ICAR Research Complex for NEH region, demonstrated zero till cultivation of pea in rice fallows. Adoption of raised and sunken bed technique permitted cultivation of other vegetable crops after rice. This technique protected the vegetable crop from excess moisture in the rice fields and gave additional returns from double cropping. Potato (Kufri Giriraj and Kufri Mega), Capsicum (Royal Wonder), Pea (Arkel), Tomato (Badshah) and French Bean (S-9) were cultivated in rice fallows during January to May. Net income from vegetable cultivation ranged from Rs.10000 to Rs.15000 from field sizes of 0.1 to 1.5 ha. Benefit cost ratios ranged from 1.8 to 2.5.

Similarly in Mizoram, zero till short duration Pea (Rachana, 110 days duration) along with mulching with crop residue was demonstrated in NICRA village in lowland rice fallows in 40 ha area on residual soil moisture. The legume crop helped in improving soil nitrogen along with additional returns from the increased cropping intensity.

Demonstration of zero till pea in rice fallows

Demonstration of zero till Pea in rice fallows in Meghalaya and Mizoram

Raised and sunken bed technique of cultivation in vegetable crops
at Meghalaya and Mizoram

Zero tillage cultivation of rapeseed-mustard in lowland rice fallows in Mizoram was demonstrated with 3 cultivars ((M-27, NPJ-113 and P-27) in farmer's fields in 80 ha area Among the varieties, NPJ-113 gave significantly higher grain yield in 90 days (12.35 q/ha), followed by M-27 in 100 days (8.81 q/ha) and P-27 in 120 days (7.9 q/ha) as compared local variety in 150 days (5.32 q/ha).

Zero till rapeseed-mustard in rice fallows (NPJ-113, M-27 and P-27)
at Chemphai, Kolasib, Mizoram

Table 9: Performance of toria cultivars under zero tillage in lowland rice fallow

Varieties	Area (ha)	Duration (days)	Yield (q/ha.)	Biomass (q/ha)	Gross Return (Rs./ha)	Net Returns (Rs./ha)	B: C Ratio
NPJ-113	30.6	120	12.4	60.8	61750	43150	2.3
P-27	15.5	100	7.9	50.6	39500	20900	1.1
M-27	20.6	90	8.8	64.5	44000	25400	1.4
Local	12.6	150	5.3	51.7	26500	7900	0.4

Apart from vegetable crops, extent of coverage of zero till cultivation in major crops is summarized in the Table 10.

Table 10: Extent of zero till cultivation practiced in NICRA villages across states in 2014-15

Crop	Cultivars	Intervention	State	District	No. of demon-strations	Area (ha)
Wheat	HD 2967, PBW 2967	Zero till drill and Happy seeder sown wheat	Punjab	Bathinda, Fatehgarh Sahib, Ropar, Faridkot	73	73
	WH 1105, HD 2967	Zero till drill and Happy seeder sown wheat	Haryana	Yamunanagar	84	33
	HD 2733, HD 2045	Zero till drill sowing	Bihar	Aurangabad, Jehanabad, Nawada, Saran	121	66
	K 7025, K 307	Zero till drill sowing	Jharkhand	Chatra	19	11
	PBW 343	Zero till drill sowing	West Bengal	Malda	100	15
	WL 711, HD 2733	Zero till drill sowing	Uttar Pradesh	Gorakhpur, Kushinagar	52	26
	MP 4010, GW-366	Zero till drill sowing	Madhya Pradesh	Datia, Morena	65	31
	GW-273	Zero till drill sowing	Chhattisgarh	Bhatapara, Bilaspur	12	4.8
Paddy	Pusa Basmati 1121	Direct seeded rice drill sowing	Punjab	Bathinda, Fatehgarh sahib, Ropar, Faridkot	32	30
	Rajendra Sweta	Zero till sowing	Bihar	Aurangabad	11	4
Greengram	TARM 1	Zero till drill sowing	Odisha	Ganjam	5	2
Maize	Kaveri 50	Zero till drill sowing	Andhra Pradesh	Srikakulam	15	5
Mustard	Pusa bold	Zero till drill sowing	Chhattisgarh	Bhatapara	5	2

3.2. Crop Production Systems

Monsoon contingency action plans were prepared and implemented by 60 NICRA KVKs which experienced delayed onset/ deficit rainfall conditions during *kharif* 2014-15. Contingency crop plans for late planting (after mid July) involving appropriate crop, soil moisture, nutrient management measures were taken up in NICRA villages. The impact of resilient practices and technologies is highlighted below:

Contingency cropping

Contingency crops, sesame (Madhuri) and sunflower (PKV 559) adopted for delayed planting (August) performed better and gave higher yields compared to late planted soybean in Takali village, Amravati district.

Contingency crop Sesame (Madhuri) and Sunflower (PKV 559)
in Amravati, Maharashtra

Sowing of short duration pigeonpea (BRG-2) for delayed onset gave yield advantage of 23.5% and B:C ratio of 3.1 compared to 2.6 with the local variety in D. Nagenahalli village, Tumakuru. Aerobic paddy (MAS-26) cultivation resulted in 14.4% yield gain and B:C ratio of 2.2 compared to 1.9 over transplanted paddy.

Short duration pigeopea (BRG 2) and Aerobic rice (MAS-26)
in Tumakuru, Karnataka

Contingency cropping of basmati rice (Pusa-1509) in 20 ha area resulted in a yield advantage of 1 q/ha over transplanted paddy in Killi Nihal Singh village, Bathinda, Punjab. Contingency measures were implemented in paddy, pigeonpea and blackgram in Lowkeshra village in East Singhbhum, Jharkhand. In paddy, short duration and drought tolerant varieties (BVD-110 and Sahbhagi) were sown by direct seeding in uplands.

Drought tolerant variety Sahbhagi dhan and Birsa Vikas Dhan-110
at East Singhbhum, Jharkhand

Contingency cropping with pearl millet demonstrated in rice fallows in 30 ha area covering 115 farmers resulted in an average yield of 29 q/ha with HHB-67 and 32 q/ha with VBH-24 in Kukurha village of Buxar, Bihar. Short duration cultivar HHB-67 is well suited for inter-and multiple cropping system and highly resistant to downy mildew and lodging.

Pearl millet (HHB-67) in rice fallows at Buxar, Bihar

In rainfed red soils in Gaddi Malayaguda village of Rangareddy, CRIDA-KVK demonstrated short duration pearl millet (80 days) developed by RARS, Palem in five farmers fields with a mean yield of 10.5 q/ha and 5 t/ha fodder yield despite deficit rainfall (-54%). Similarly, castor was taken up as a contingency crop (DCS-107), which gave double the yield (6.1 q/ha) of local variety.

In the same village in Rangareddy district, Telangana, early sown maize with receipt of showers in the first week of June experienced prolonged dry spell subsequently leading to stunted growth and low yield (5.5 q/ha). Horsegram (CRHG 18R) was adopted by 60 farmers during September and realized grain yield of 5 q/ha and fodder yield of 5 q/ha.

Drought tolerant pearl millet
in Rangareddy district

Horse gram (CRHG 18R)
as contingency crop

Short duration and drought tolerant varieties

During the current year (2014) delayed onset of monsoon was experienced in several districts and a number of short duration and drought tolerant varieties were demonstrated to make effective use of the remaining growing season.

In Umarani village of Nandurbar, onset of monsoon was delayed by about 4 weeks (14 July 2014). Farmers usually cultivate local maize (Ayatali mokay) which is low yielding and of long duration. A short duration variety of maize (75-80 days), GM-6 was demonstrated in 10 farmers' fields covering 4 ha. GM-6 escaped the terminal drought and increased the yields by 18.4% compared to the local cultivar (Table 11).

Table 11: Demonstration of short duration maize (GM-6)

Treatments	Seed yield (kg/ha)	Fodder Yield (kg/ha)	Cost of cultivation (Rs/ha)	Net income (Rs/ha)	B:C ratio	Yield advantage (%)
Farmers practice (Ayatali mokay)	1830	6500	13050	24655	2.9	18.4
Improved variety (GM-6)	2167	6500	13630	28624	3.1	

In Nidhan and Jeghani village of Morena district, short duration pigeonpea (ICPL 88039) was introduced in 25 ha area. The sowing time for this variety is from mid June to first week of July and can be taken up for late planting. Farmers harvested about 18-24 q/ha and also took up timely sowing of wheat in the *rabi* season.

Short duration pigeonpea (ICPL-88039) at Morena, MP

Farmers of the West Garo Hills grow paddy with a seed rate of 75-80 kg/ha and transplant 35-45 days old seedlings in traditional method of cultivation, which is responsible for low productivity. Staggered planting of rice variety Gitesh was introduced in NICRA village to facilitate transplanting of 30-75 days old seedlings without adverse effect on tillering capacity to tackle delay in onset of monsoon and deficit rainfall conditions experienced in 2014-15.

Table 12: Demonstraion of staggered planting of rice

Technology demonstrated	Yield (q/ha)		% increase in yield	Economics of demonstration (Rs./ha)		
	Gitesh	Local variety		Gross return	Net return	BC ratio
Staggered planting of *Sali* paddy	43.9	23.5	56.6	65790	42377	2.8

Gitesh variety for contingency situations in transplanted paddy at West Garo Hills, Meghalaya

In Bhoimunda village of Jharsuguda, onset of monsoon was delayed by 10 days during 2014-15. Short duration paddy variety (Sahbhagi dhan) tolerant to moisture stress was demonstrated in *kharif* 2014 in 6 ha involving 20 farmers, which resulted in 33% yield over the farmers' practice (24 q/ha) with a B:C ratio of 2.3.

Short duration paddy variety Sahbhagi dhan at Jharsuguda, Odisha

In Kathua, wheat variety RAJ-3765 yielded higher yield (34.5 q/ha) over the farmers' practice of PBW-175 (14.4 q/ha) with a B:C ratio of 6.1. The variety is tolerant to soil moisture stress and resistant to yellow rust disease.

Drought tolerant wheat variety at Kathua, J&K

In Kullu, grain yield of high yielding, drought tolerant and yellow rust resistant variety of wheat (HPW 155) ranged from 19.9-32.8 q/ha compared to the farmers' practice of susceptible variety (15.3 to 17.5 q/ha) while HPW-155 crop was free from infestation of yellow rust.

Drought affected wheat crop at Kullu, HP

Improved wheat variety (HPW-155) at Kullu, HP

In Rupana village of Sirsa about 120 ha area is affected with salinity. Introduction of salt tolerant wheat variety (KRL-213) during 2014-15 resulted in uniform germination and good crop stand. KRL 210 was also introduced in the village by the KVK in 2013-14 but the performance of KRL 213 was better than KRL 210.

Table 13: Performance of salt tolerant variety over farmer's practice

Variety	No. of farmers	Area (ha)	Yield (q/ha)	Economics of Demonstration (Rs./ha)		
				Gross return	Net return	BC ratio
KRL 210	80	32	34	49300	18800	1.6
KRL 213	15	6	39	56550	26050	1.8

Salt tolerant wheat variety (KRL-213) at Sirsa, Haryana

Farmer's practice at Sirsa, Haryana

In Khammam district of Tealangana, significant area is affected by salinity. Salt tolerant paddy variety (WGL-44) performed well in saline fields of six farmers (6.1 t/ha).

Salt tolerant paddy variety (WGL-44) at Khammam, Telangana

Summary on performance of short duration & drought tolerant varieties is furnished in Tables 14 and 15, respectively.

Table 14: Performance of short duration varieties across different districts

Crop	Variety	No. of farmers	Area (ha)	Demo yield (q/ha)	Farmers practice yield (q/ha)	B:C ratio	District
Blackgram	PU-35	20	8.0	11.5	10	3.1	Chhatarpur
	Sekhar	7	2.0	7.8	6.2	2.2	Gumla
	Pusa Vishal	14	1.5	8.9	6.2	3.6	Koderma
	CO-6	6	3.0	8.3	7.15	3.0	Namakkal
	Samrat	10	3.0	7.6	2.05	1.8	Satna
Greengram	PDM-139	25	4.3	8.6	6.0	3.0	Chitrakoot
	VBN-3	7	5.0	8.5	7.3	3.3	Namakkal
Groundnut	TG 37A	30	12.0	10.0	8.0	2.7	Chhatarpur
	TG-38	20	8.0	11.4	10.6	1.6	Rajkot
	ICGV-91114	2	1.0	10.1	9.2	2.1	Tumakuru
Maize	HQPM-1	89	10.0	42.0	30.0	6.1	Palamu
	Suwan-1	21	6.0	35.6	28.2	2.1	Gumla
	GM-6	10	4.0	21.7	18.3	3.1	Nandurbar
Paddy	Anjali	26	17.0	29.0	19.0	1.9	Chatra
	Birsa Vikas Dhan 110	10	2.5	30.0	23.0	2.3	E.Singhbhum
	Naveen	10	2.0	39.0	20.0	2.4	E.Singhbhum
	PR-121, 122	75	50.0	73.8	71.3	2.5	Faridkot
	Lalat	42	20.0	60.9	51.6	1.8	Gumla
	Sahabhagi	30	37.5	37.6	28.3	2.0	Jehanabad
	Sahabhagi	20	6.0	32.0	24.0	2.3	Jharsuguda
	Gitesh	10	2.0	43.8	23.5	2.8	West Garo Hills
	WGL-44	5	2.0	61.2	55.8	1.4	Khammam
	Shasarang	35	1.5	38.3	28.9	1.9	Ri Bhoi
	MAS-26	5	2.0	32.5	28.4	2.2	Tumakuru
Pigeonpea	TJT-501	6	2.0	15.0	11.2	1.3	Balaghat
	ICPL-88039	10	5.0	12.0	4.0	4.1	Datia
	BRG-2	32	3.0	11.3	10.2	2.8	Tumakuru
	BRG-4	15	5.0	12.6	10.2	3.1	Tumakuru
Soybean	JS-9305	62	24.8	25.6	18.35	2.5	Amravati

Table 15: Performance of drought tolerant varieties

Crop	Variety	No. of farmers	Area (ha)	Demo yield (q/ha)	Farmer practice yield (q/ha)	B:C ratio	District
Chickpea	Akash	20	8.0	16.3	-	1.6	Aurangabad
	JG-11	33	7.8	15.6	11.2	2.5	Belgaum
	JG-74	6	2.4	6.0	4.0	2.3	Bilaspur
	KPG-59	151	35.0	14.0	8.0	2.9	Palamu
	Pusa-256	3	1.5	22.7	-	4.3	Jehanabad
Greengram	BM-2003-2	20	8.0	12.5	10.0	2.7	Aurangabad
	PDM-139	25	4.3	8.6	6.0	3.0	Chitrakoot
	Pratap	2	1.0	8.0	7.1	2.4	Dimapur
	VBN-3	7	5.0	8.5	7.3	3.3	Namakkal
Groundnut	TG 37A	30	12.0	10.0	8.0	2.7	Chhatarpur
	JGN-23	9	2.5	11.0	8.5	2.0	Datia
	CO 6	14	2.6	18.5	14.5	3.4	Namakkal
	TG-38	20	8.0	11.4	10.6	1.6	Rajkot
Maize	Suwan-1	21	6.0	35.6	28.2	2.1	Gumla
	4640	4	1.0	26.0	21.0	1.9	Hamirpur
	Bajaura Makka	33	3.0	26.6	19.2	1.4	Kullu
	Girija	36	3.5	29.5	21.5	1.5	Kullu
Mustard	RVM-2	12	5.0	16.3	11.4	3.2	Datia
	Pusha	8	5.0	12.3	8.6	2.2	Gumla
	Rohini	5	1.0	13.5	12.2	3.2	Jhansi
Pigeonpea	TJT-501	6	2.0	15.0	11.2	1.3	Balaghat
	ICPL 87119	20	1.0	8.5	12.0	2.4	E.Singhbhum
	NDA-1	38	15.0	12.6	9.8	2.6	Sonabhadra
	BDN-711	20	8.0	11.5	10.0	2.0	Aurangabad
	ICPL-85063	22	4.8	7.0	4.0	2.0	Bilaspur
	ICPL-88039	12	3.0	6.3	2.1	1.0	Satna

Crop	Variety	No. of farmers	Area (ha)	Demo yield (q/ha)	Farmer practice yield (q/ha)	B:C ratio	District
	BRG-4	15	5.0	12.6	10.2	3.1	Tumkur
	Asha- 87119	34	13.6	13.6	-	1.3	Kurnool
Safflower	JSI-7	15	5.0	6.0	4.0	3.0	Bilaspur
Sesamum	GT-10	17	6.8	4.0	2.0	4.0	Bilaspur
	JTS-8	24	9.6	5.0	3.5	2.3	Chhatarpur
	Pragati	15	3.0	5.6	4.4	2.0	Sonabhadra
Sorghum	Parbhani moti	60	24.0	45.0	25.0	1.2	Aurangabad
Soybean	JS-9305	62	24.8	25.6	18.35	2.5	Amravati
	MAUS-71	30	12.0	11.4	10.1	1.5	Aurangabad
	JS 9560	30	12.0	8.0	5.0	1.2	Chhatarpur
	JS 9560	13	4.8	11.2	7.8	1.7	Datia
	JS-335	2	1.0	11.0	8.5	1.5	Dimapur
	JS-335	5	5.0	12.5	-	1.4	Khammam
	Harit Soya	78	4.0	13.2	9.5	2.2	Kullu
	PS-1092	47	1.0	12.4	8.2	2.1	Tehri-gorwal
	JS 9560	10	5.0	13.6	9.6	2.4	Tikamgarh
Wheat	WSM-1472	5	2.0	18	15	2.3	Amravati
	Netravati	20	8.0	23.8	19.5	1.6	Aurangabad
	Raj-3765	63	29.0	29.0	14.0	3.0	Kathua
	K-307	83	12.0	37.9	32.8	1.8	Koderma
	K-9107	180	28.5	25.5	6.0	1.9	Palamu
	HPW-155	5	2.0	23.0	17.0	1.4	Kullu
	KRL-213	15	6.0	39.0	34.0	1.8	Sirsa
	DBW-17	25	5.0	42.6	36.4	2.0	Sonabhadra
Foxtail millet	HA-4	18	7.2	18.5	14.7	2.3	Davanagere
Pearl millet	HHB-67	250	100	12.5	10.25	2.1	Jodhpur
Barley	JB-58	24	10	16	12	1.9	Chhatarpur

Crop	Variety	No. of farmers	Area (ha)	Demo yield (q/ha)	Farmer practice yield (q/ha)	B:C ratio	District
Barnyard millet	PRJ-1	47	2.5	16.8	14.2	1.9	Tehri-garhwal
Moth bean	CZM-2	25	25	5.75	4.5	4.1	Jodhpur
Niger	Birsa Niger	27	10	4.6	2.85	1.6	Gumla
Finger millet	A404	19	7	14	9	2.5	Chatra
	GPU-28	132	22	16.5	13.2	1.8	Gumla

Flood tolerant varieties

In Sirusuwada village of Srikakulam district, AP which is frequently affected by floods, tolerant paddy varieties were compared with that of farmers' practice (Swarna and Pooja varieties). RGL-2537 recorded higher grain yield (58 q/ha) followed by MTU-1061 (Table 16) in low inundation area whereas in high and medium inundation areas all the flood tolerant varieties were affected by flood.

Table 16: Performance of flood tolerant varieties in Srikakulam, AP

Particulars	Paddy cultivars					
	MTU-1061	MTU-1064	RGL-2537	PLA-1100	Swarna	Pooja
Average yield (q/ha)	54	52	58	51.4	47.5	48.4
Cost of cultivation (Rs/ha)	38750	38750	38750	38750	38750	38750
Gross returns (Rs/ha)	69120	66560	74240	65792	60800	61952
Net returns (Rs/ha)	30370	27810	35490	27042	22050	23202
B:C ratio	1.78	1.71	1.91	1.69	1.56	1.59

Flood tolerant paddy varieties
(PLA-1100, RGL-2537) at Srikakulam, AP

Flood affected paddy (Pooja)
at Srikakulam, AP

In Undi village of West Godavari, AP, paddy variety Swarna (MTU-7029) is grown during the *kharif* season which is prone to lodging due to heavy rainfall. Lodging resistant varieties (MTU-1061 and MUT-1064) were adopted by farmers. Due to cyclone, complete lodging of MTU 7029 (Swarna) was observed and the lodged crop was affected by Brown Plant Hopper (BPH). Lodging damage in MTU-1061 and MTU-1064 was less and also hopper burn was comparatively less.

Table 17: Performance of flood & lodging tolerant varieties in West Godavari, AP

Variety	Seed yield (kg/ha)	Incidence of hopper burn (%)	Cost of cultivation (Rs/ha)	Gross income (Rs/ha)	Net income (Rs/ha)	B:C ratio
MTU-1061	5975	50	40892	76867	35975	1.87
MTU1064	5905	45	39462	81112	41650	2.41
MTU-7029 (Farmers practice)	5247	75	45357	66857	21500	1.47

Lodging damage in susceptible variety
(MTU-7029) at West Godavari, AP

Flood tolerant paddy (MTU-1061)
at West Godavari, AP

In Udmari village of Dubri, Assam inundation due to flash flood during *kharif* season is common and flood water recedes in 2 to 12 days. Farmers' are unable to cultivate winter rice (*Sali*) in time because of flood water and mainly adopt some traditional local late *Sali* varieties for cultivation. Submergence tolerant rice varieties (Jalashree and Swarna Sub 1) were adopted by farmers during 2014. The tolerant varieties were found to be superior in terms of crop yield (30.4 and 33 q/ha, respectively) which was 9.6 and 22.2 % higher respectively, over late *Sali* variety (Jalashree) which also performed well in low lying flood-prone fields of Barak valley in Cachar, Assam.

Flood tolerant paddy varieties (Jalashree and Swarna Sub-1) at Dhubri, Assam

In Dhubri, cultivation of rice as summer crop or as early *Ahu* is a common practice to compensate loses in *kharif* crop due to flood. Early *Ahu* crop is transplanted in the month of February and this crop is often submerged by flood water at the time of harvesting leading to crop loss due to susceptibility, of existing varieties to lodging. Summer rice variety (Joymoti), a non-lodging variety was adopted by farmers in the NICRA village to cope with recurrent flooding. Introduction of this variety facilitated early *Ahu* cropping and resulted in increased crop yields by 21% with higher net returns (Rs. 19,000/ha).

Rice is the main crop in Barak Valley of Cachar, Assam. Demonstration of post-flood tolerant rice variety (Dishang) was undertaken to tackle post flood situation as the variety is of shorter duration, is photo-insensitive and fits into double cropping with winter vegetables after rice. Farmers realized grain yield of 32.8 q/ha in 2014-15.

In Haral village of Ratnagiri, Maharashtra, lodging resistant rice varieties (Karjat-2 and Karjat-6) were adopted by 15 farmers covering an area of 3 ha to overcome the problem of lodging and poor yield. Farmers realized higher yields with Karjat-2 (51 q/ha) and higher net returns compared to the local variety which suffered lodging damage due to heavy rains (23% crop damage) (Table 18).

Table 18: Demonstration of lodging resistant paddy cultivars

Variety	Lodging (%)	Grain yield (q/ha)	Straw yield (q/ha)	Cost of cultivation (Rs/ha)	Gross income (Rs/ha)	Net income (Rs/ha)	B:C ratio
Local variety	23.0	31.6	40.0	34,600	38,760	4,160	1.1
Karjat-2	No lodging	42.4	51.0	36,400	51,640	15,240	1.4
Karjat-6	No lodging	38.0	41.0	36,400	45,822	9,222	1.3

Lodging resistant rice variety (Karjat-2) at Ratnagiri, Maharashtra

Lodging in local variety due to heavy rain at Ratnagiri, Maharashtra

In Khunthli village of Valsad, Gujarat, flood tolerant paddy variety (GAR-13) which is high yielding, short duration, dwarf and resistant to water logging was adopted in 20 ha by 40 farmers with an avearge yield of 3112 kg/ha, which is significantly higher over that of farmers practice.

Lodging resistant rice variety (GAR-13) at Valsad, Gujarat

The summary of interventions involving tolerant varieties in various flood prone areas is furnished in Table 19.

Table 19: Performance of flood tolerant varieties of paddy in different districts

Variety	No. of farmers	Area (ha)	Demo yield (q/ha)	Farmers practice yield (q/ha)	B.C ratio	District
Gitesh	14	4	40.5	27.0	2.1	Dhubri
Jalashree	2	1	30.4	27.0	1.7	Dhubri
Karjat-2	32	6.2	42.4	31.6	1.4	Ratnagiri
Karjat-6	32	6.2	38.0	31.6	1.3	Ratnagiri
Lalat	10	2	48.7	42.0	2.1	Kendrapara
Luit	6	3	26.3	21.4	1.5	Dhubri
MTU-1064	15	18	57.4	52.5	1.8	West Godavari
MTU-1140	15	18	60.0	52.5	1.9	West Godavari
Swarna sub-1	10	4	33.0	27.0	1.8	Dhubri
	10	4	42.8	41.5	2.0	Kendrapara
RGL-2537	74	0.4	53.9	45.0	1.8	Srikakulam

Resilient intercropping systems

Various intercropping systems were demonstrated in regions which are prone to drought. Intercropping systems are considered as one of the important adaptation mechanism for variable rainfall situations.

In Shetka village of Aurangabad, Maharashtra, cotton + greengram and cotton + blackgram (1:1) were sown on 24th July and soybean + pigeonpea (4:2) were sown on 26th July in 20 farmers' fields in 8 ha during *kharif*, 2014. The village received 327 mm rain during June-September against a normal rainfall of 538 mm. Soybean + pigeonpea (4:2) intercropping system performed better compared to the delayed sown sole crop of soybean. Similarly, cotton intercropping with greengram performed better than late sown sole crop (Table 20).

Table 20: Impact of intercropping system over sole cropping at Aurangabad, Maharashtra

Treatments	Seed yield (kg/ha)		Cost of cultivation (Rs/ha)	Gross income (Rs/ha)		Net income (Rs/ha)	B:C ratio	Yield advantage (%)
	Main crop	Inter-crop		Main crop	Inter-crop			
Cotton sole	1550	-	30500	62000	-	31500	2.0	-
Cotton + Greengram (1:1)	1340	600	38500	53600	30000	45100	2.2	41
Cotton + Blackgram (1:1)	1200	575	38500	48000	28750	38250	2.0	21
Soybean sole	1200	-	23760	42000	-	18240	1.8	-
Soybean + Pigeonpea (4:2)	1000	600	24100	35000	36000	46900	2.3	61

Cotton + Greengram (1:1) at Aurangabad, Maharashtra

Soybean + Pigeonpea (4:2) at Aurangabad, Maharashtra

During *kharif* 2014, intercropping systems of maize + pigeonpea at Davangere, pigeonpea + blackgram at Koderma, pigeonpea + pearl millet and soybean + pigeonpea at Aurangabad performed well. Among *rabi* crops, intercropping of *rabi* sorghum + chickpea at Belgaum performed well compared to farmers' practice of sole cropping.

Table 21: Performance of various intercropping system across districts

Crop	No. of farmers	Area	Eq. yield in Demo (q/ha)	Eq. yield in FP (q/ha)	B:C ratio	District
Groundnut + Pigeonpea (4:1)	2	1.0	16.7	15.2	2.2	Gumla
Maize + Pigeonpea (6:2)	102	40.0	54.5	44.5	2.6	Davanagere
Soybean + Pigeonpea (6:2)	33	13.2	21.5	18.0	2.2	Amravati
Soybean + Pigeonpea (4:2)	10	0.4	16.0	12.0	2.3	Aurangabad
Pigeonpea + Pearlmillet (3:3)	10	0.4	20.0	16.0	1.4	Aurangabad
Rabi Sorghum + Safflower (6:3)	10	0.4	29.0	28.0	1.4	Aurangabad
Maize + Pigeonpea	15	7.0	32.0	28.0	3.0	Chatra
Pigeonpea + Blackgram	20	2.0	16.6	8.1	3.4	Koderma
Pigeonpea + Sorghum	2	1.0	10.4	8.9	1.9	Gumla
Rabi Sorghum + Chickpea	40	16.0	28.8	24.5	2.8	Belgaum
Safflower + Chickpea	10	4.0	27.0	22.8	2.9	Belgaum

Crop diversification

In Yagantipalli village of Kurnool, AP, climate resilient crops served as an insurance against crop failure due to drought. Farmers traditionally grow cotton which gives lower yields during drought years which is common in this village and farmers incur losses due to higher cost of cultivation.

Short duration foxtail millet varieties (SIA-3085 and Suryanandi) were demonstrated in 12 ha area with an average yield of 19.5 q/ha with net returns of Rs. 11,820/ha apart from the biomass used as fodder. The short duration varieties matured early by 10-15 days compared to local check and reduced the adverse impact of terminal drought condition. More than 60% of farmers in the village have adopted this practice during the project period.

Foxtail millet (Suryanandi)
at Kurnool, AP

Foxtail millet (SIA-3085)
at Kurnool, AP

In Bhoimunda village of Odisha, Jharsuguda, maize was adopted as an alternate crop to upland paddy in 5.0 ha by 27 farmers with an average yield of 38.0 q/ha with a B:C ratio of 3.4 compared to 2.2 in famers practice.

Maize as an alternate to paddy in uplands at Jharsuguda, Odisha

In Chakrayapeta village of Anantpur, AP, cluster bean (HG-365), sorghum and greengram were introduced in place of groundnut for late planting in August. During crop growth period, only 90 mm of rainfall was received in 6 rainy days and the crops experienced dry spells. Cluster bean performed better and recorded higher net returns (Rs.20625/ha) under late planted conditions and can fit in as a contingency crop in Anantapur in addition to its potential as a dual purpose crop in the district under normal rainfall conditions.

Soil health management

In Nalgonda, soil test based nutrient management was taken up in cotton. About 30 soil samples were collected from Nandhyala gudem, Atmakur(S) mandal, all the soil samples ware low in organic content. The available nitrogen was low i.e less than 280 kg/ha and the available P_2O_5 was low to medium and available potash was low to medium. Follwing the recommendation of 80:24:24 NPK kg/ha as against the existing practice of 120:60:50 NPK kg/ha, farmers could save Rs. 1200 - 1500/ha towards the cost of fertilizers due to soil test based nutrient application.

In Hengbung village of Senapati, Manipur, liming was done in acid soils with recommended dosage of 500 kg of agricultural lime/ha to overcome soil acidity in 5 farmers' fields where the pH ranged from 5.1 to 5.43. The average yield of groundnut in lime treated plots was 16 q/ha whereas yield was low 12.8 q/ha in farmer practice (without liming).

Groundnut crop in lime amended soil at Senapati, Manipur

Greengram variety SML-668 in Kendrapara

KVK Muzaffarnagar prepared 747 soil health cards in the adopted village of Rasoolpur Jatan and based on the soil test results, farmers were advised on nutrient application in sugarcane.

In Pindi Blochan village of Faridkot, Punjab, summer moong (SML 668) was adopted for improvement of soil health by 73 farmers in 28 ha area. The variety suited well in rice - wheat rotation with aditional benifit of Rs. 4000 - 5000 /ha.


Summer moong (SML-368) in Faridkot, Punjab

In Bhargawan village of Satna district in Madhya Pradesh farmers generally sow local variety of greengram which is a low yielder. An improved variety (PDM-139) of greengram was introduced with seed treatment (Thiomethoxam @ 3gm/kg) by furrow irrigated raised bed (FIRB) method in 4 ha area involving 16 farmers yield advantage was 7.5 q/ha as compared to farmers practice (4.6 q/ha).

3.3. Livestock and Fisheries Production Systems

Livestock and fisheries production systems are important livelihood enterprises in drylands and coastal agroecosystems, respectively. Opportunities also exist for fish producation in ponds in high rainfall areas in the East and North East.

In this module, interventions include introduction of stress tolerant animal and poultry breeds, nutrient supplementation through area specific mineral mixtures, balanced ration using locally available feed material, fodder production in community lands especially during drought/flood situations, silage making for storage of green fodder and feeding during the dry season, improved shelters for reducing heat stress in livestock, captive rearing of fish seed in nursery ponds prior to stocking in main tanks in the village, breed selection and stocking ratios for fish production in farm ponds and monitoring of water quality in aquaculture and integrated farming system models in diverse agro ecosystems. Highlights of technology interventions are given below:

Introduction of stress tolerant breeds

Productive and stress tolerant breeds of animals were introduced in NICRA villages especially improved poultry breeds of Vanaraja and Gramapriya (Dimapur, Dibrugarh, East Sikkim, Lunglei, Ri Bhoi, Senapati, Cooch Behar), Rajashree (Anantapur), Kalinga Brown (Cachar), Chabro (Jhansi) and Kadaknath (Balaghat). Improved breeds of goat such as Sirohi (Ahmednagar, Augrangabad & Nandurbar) Jamunapari and Lalitpuri (Datia) and sheep such as Telichery and Nari Suvarna (Namakkal) were adopted by farmers. Performance fo improved breeds of pig such as Hampshire Cross, Ghungroo, Duric, White Yorkshire were evaluated by farmers along with improved housing in the North East. Resilience and impact of introduction of improved breeds on farmers income is being assessed at all the locations.

Fodder production with improved cultivars

Adequate supply of fodder, either green or dry, is crucial to the livelihoods of livestock in rainfed areas. In 2014-15, delayed onset and deficit rainfall conditions were experienced in several states. There was reduction in area under millets and pulses, which are important to meet the fodder requirements in the rainfed areas. Short and medium duration fodder cultivars of several crops and fodder species both in *kharif* and *rabi* seasons were demonstrated in farmers' fields under rainfed and limited irrigation conditions to support income and cash flow from animal husbandry in view of the below normal monsoon season in 2014-15. For example, in Sakrorha village of Jehanabad, actual rainfall received during June to September was 439 mm which was -46% of the normal rainfall of 839 mm. Livestock farmers were encouraged to take up fodder cultivation of sorghum and pearl millet in *kharif,* and oats (JHO 822) and berseem (Vardan) in *rabi* to enhance fodder production by 22-25% more than the local varieties. Increase in availability of quality fodder throughout the year increased milk production by 39% and farmer's income increased by Rs. 70/day/ animal.

Table 22: Demonstrations on fodder production in deficit rainfall areas

State	District	Fodder crops and cultivars
Uttar Pradesh	Bahraich, Chitrakoot, Gonda, Gorakhpur, Jhansi, Muzaffarnagar, Sonbhadra	Sorghum (Pusa chari-6), Berseem (Vardan, JHB-146), Oat (JHO 822), Hybrid Napier (NB-21, PB-21)
Bihar	Supaul, Buxur, Jehanabad, Aurangabad, Saran	Maize (African tall, M.P Chari), Cow pea (Co-5), Oat (JHO 822), Sudan Grass, Pearl millet (HHB-67)

State	District	Fodder crops and cultivars
Telangana	Khammam, Nalgonda	Multi-cut sorghum (Sugar graze), Hybrid Napier (APBN-1)
Andhra Pradesh	Anantapur	Hybrid Napier (Co-4)
Maharashtra	Ahmednagar, Amravati, Nandurbar	Multicut fodder (Nutrifeed), Maize (Yashwant), Lucerne (RL-88)
Gujarat	Valsad	Perennial Grass (Co-1, Co-2 and Co-4)
Punjab	Fatehgarh Sahib, Faridkot	Maize (J-1006)
Madhya Pradesh	Balaghat, Datia, Morena	Barseem (BL-1, BB-3), Maize (J-1006, MP Chari), Oat (JHO-851)
Tamil Nadu	Namakkal	Sorghum (CoFS-29)

Silage making

Delayed onset and deficit rainfall conditions prompted adoption of silage making of green fodder in NICRA villages of Pune, Ahmednagar, Kurnool, Khammam, Faridkot and Saran, Hamirpur and Kullu districts. Cultivation of fodder maize, giant pearl millet and multicut fodder sorghum were taken up by several farmers to prepare silage using poly bags, plastic drums and silo pits. In Nirmal Pimpri village of Ahmednagar, late onset of monsoon by a month with no rain in June (-100%) and deficit rainfall conditions in July (-31%) led to decrease in area under soybean and pearl millet with increase in area under fodder sorghum (sugar graze), giant pearl millet (Nutrifeed) and multi-cut perennial fodders (Jaywant and Co-4). With deficit rainfall in September (-83%), *kharif* crops did not perform well with low grain and fodder yield. Silage making of chopped green fodder was taken up by farmers adopting both pit, tower and poly bag (500 kg size) methods of silage making. About 197 livestock owners used silage making in poly bags to meet the requirements of fodder during the summer and prepared 263 tonnes of silage in 2014-15. Silage was prepared during the month of December to February. Some farmers reused these bags for repeated silage making and silage was fed to animals at 15-18 kg/ day. The practice saved costs towards purchase of green fodder from outside while increasing the income by Rs 3.93 lakh in the NICRA villages from increase in milk yield and quality.

Table 23: Silage preparation in bags in NICRA villages of Ahmednagar, Maharashtra

Method of silage making	NICRA village	Farmers adoption (No.)	No. of bags produced (500 kg capacity)	Quantity produced (Tonnes)
Silage bag	Nirmal Pimpri	146	281	168.6
	Pimpri Lokai	44	47	28.2
Pit method	Nirmal Pimpri	4	-	34.6
Tower method	Nirmal Pimpri	3	-	30.0
	Total	197	328	262.4

Silage preparation in poly bags helps livestock farmers to tide over green fodder shortage during summer at Ahmednagar, Maharashtra

In Yagantipalle village of Kurnool, to meet green fodder requirement during summer, silage making in bags was introduced in the village during 2014-15 due to its lower production cost compared to pit method. Farmers preserved chopped green fodder from maize in silage bags of 500 kg capacity sufficient to feed one milch animal @ 5kg/day. Farmers practice of feeding sorghum straw with feed gave a milk yield of 374 liters over a two month period while supplementation with silage yielded 432 liters / animal. Milk yield increased by 15.5% with BC ratio of 1.46 compared to farmers practice of feeding only dry fodder.


Silage making demonstration in poly bags and pits at Yangantipalle village, Kurnool, AP

Balanced ration for increasing milk yield

In Sitara village of Bharathpur, about 20 livestock owners practicing animal husbandry with Murah breed of buffaloes were introduced to adoption of balanced ration coupled with feeding of urea molasses bricks (UMB), deworming and mineral mixture supplementation. The intervention led to increase in milk yield by 15-20% and improvement in overall health status. The practice was adopted by 90% of the 180 cattle owners leading to increase in milk production by 500 liters per day in the village.



Adoption of balanced ration and urea molasses bricks (UMB) at Bharatpur, Rajasthan

In Umarani village of Nandurbar, feeding of area specific mineral mixture to 20 pregnant and lactating cows led to healthy new born calves and improvement in milk yield by 24 liters per animal over a two month period.

Area specific mineral mixture for improved reproductive health of cattle at Nandurbar, Maharashtra

In Jalgaon (KP) village of Baramati, introduction of salt tolerant marvel grass (*Dichanthium annulatum* Forssk.) cultivar (Phule Govardhan) in saline soils resulted in 29% increase in biomass over fodder sorghum under deficit rainfall conditions as well.

Farmer adopts marvel grass in saline soils in Jalgaon KP village, Baramati, Maharashtra

Integrated farming system (IFS) models for enhanced resilience

In areas prone to floods and extreme weather events such as frost/ cold stress in addition to water scarcity, monocropping is generally practiced. In these vulnerable areas, dependence on single farm enterprises by farmers is risky as they have limited resilience to cope with climate variability. Livelihood diversification opportunities were explored and demonstrated by adopting location-specific IFS models combining small enterprises such as crop, livestock, poultry, piggery, fish and duck rearing in NICRA villages.

In Bhongeri village of South 24 Parganas district, through land shaping treatment monocrop paddy area was converted to an area with multiple cropping options in addition to transforming into an integrated farming system model. In lowland paddy fields prone to water logging, 20% area was excavated to create a dug out pond of 8-9 ft depth. The excavated soil was spread in the main field and embankments. Improved short duration rice cultivars in *kharif* and raising of vegetables during *rabi* significantly enhanced the income from crop diversification. Additional income came from fish and duck rearing in the dugout pond. This model initially demonstrated to 10 farmers was adopted by 24 farmers in 7.26 hectares in 2013-14 and expanded to 71 farmers in 18.88 ha of area in 2014-15.

IFS model after land shaping in Bhongeri village,
South 24 Parganas, West Bengal

In Dhansiripar vilalge of Dimapur, introduction of composite fish farming in 2 ha area involving 5 farmers significantly increased the income during 2014-15. Initially, liming was taken up @ 1 tonne/ha as the water was moderately acidic (pH 6.4). Six fish species viz., Catla, Rohu, Mrigal, Silver Carp, Grass Carp and Common Carp were stocked in the tank for 8 months. The major expenditure included cost of feed, fingerlings and lime amounting to Rs. 32,600/ha plus other miscellaneous costs. About 886 kg/fish was produced and marketed at an average sale price of Rs 150/kg with a net return of Rs 82580/ha with a BC ratio of 3.53.

Composite fish production in Dhansiripar village at Dimapur, Nagaland

Shri Pateria, a progressive farmer from NICRA village in Datia, adopted an integrated farming system model with a farm pond and utilized the harvested rainwater to cultivate field crops, vegetables, dairy and fish production. Fingerlings of Catla, Rohi, Mrigal and grass carp were introduced into the pond. Crop residues and dung from the dairy was used for preparation of compost and biogas. Slurry was used for application in field and vegetable crops and harvested water for critical irrigations. Net returns from the IFS model was Rs 52000 with a BC ratio of 1.7. About 50% of the cost of dugout pond could be recovered in the first year.

Integrated farming system model with different components at Datia, MP

Housing for backyard poultry

Backyard poultry farming is an inseparable part of rural housholds in the North East region as it plays an important role in improving the economic status and fulfilling the protein requirement of the household. In Kyrdem village, Ri Bhoi, Meghalaya about 32 farmers adopted 20 birds each of Vanaraja breed. Farmers were advised on lost cost poultry housing made from locally available materials like bamboo and thatch grass. The low cost housing improved survival of birds, their weight gain and egg production compared to local breeds without housing.

Demonstration of improved low cost housing for poultry at Ri Bhoi, Meghalaya

Performance of pig breeds at different altitudes in Mizoram

Hampshire and Yorkshire crossbreds and Mizo local pigs (Zovawk) were evaluated on the basis of growth rate and performance at different altitudes under farmers' field conditions in different districts of Mizoram. Mizo local pigs (Zovawk) produced less meat, litter size as compared to crossbreds. Crossbred pigs had lower age at first farrowing, farrowing interval, higher growth and lower mortality during pre and post weaning, larger litter size and weight at birth and weaning. Crossbreds with 50-87.5% exotic inheritance were found to be suitable under Mizoram conditions.

Table 24: Comparative performance of crossbred pigs

Economic trait	Mizo local pig (Zovawk)	Crossbred
Age at first farrowing (months)	12-13	14
Farrowing interval (months)	4-7	7
Litter size at birth	4-6	8-12
Litter size at weaning	5	8
Birth weight (kg)	0.50-0.81	1.52-1.62
Weaning weight (kg)	4.21	8.12
Gestation period (days)	110-120	110-114

Evaluation of crossbred pigs by farmers at Lunglei, Mizoram

Fish production in pokkali farming of paddy

CMFRI KVK, Ernakulam demonstrated farm gate markets for live Karimeen (pearlspot) and Thirutha (Mullet) cultured organically in Pokkali fields. Water quality of the Pokkali fields was monitored to prevent adverse effects of fertilizers on fish prodution. Branding and implementation of farm gate market while ensuring safe-to eat product for the consumers showed potential of fetching reasonable price for the produce and enhance the income from Pokkali farming for its sustainability.

Feed formulation ‘Pearl Plus’

CMFRI developed a formulated feed for pearl spot and was launched by KVK, Ernakulam in the brand name of *‘Pearl Plus’*. Entrepreneurship development program on climate resilient aquaculture was organized by the KVK involving graduate students.

Pearl plus: formulated feed for Pearl spot

Advisory services to livestock farmers

Transfer of Technology Division of the National Dairy Research Institute (NDRI) is implementing technology demonstrations to address heat stress vulnerability and fodder scarcity in adopted village cluster comprising of Manglora, Dilawara and Suhana villages in Karnal district. A calendar in Hindi was made available to 300 farmers for advising appropriate livestock interventions and activities to be taken up in each month of the year along with creation of awareness on detection of heat symptoms in dairy animals.

3.4. Institutional Interventions as enabling support systems

In this module, an innovative institutional intervention is the formation of village climate risk management committees (VCRMCs) comprising of 12-20 villagers in all the 100 NICRA villages. VCRMCs play a crucial role in mobilizing the communities in the village for active participation. VCRMC manages the custom hiring centre for farm implements and miro-irrigation systems, seed and fodder bank, community nurseries, collection of farmers share in planting material and inputs, establishment of small weather station in the village, participation of farmers in capacity development programs and exposure visits to learning sites.

Custom Hiring Centre (CHC) for farm implements

Timeliness of agricultural operations is crucial to cope with climate variability, especially in case of sowing and intercultural operations. Access to implements for planting in ridge-furrow, broad bed furrow and raised beds is essential for widespread adoption of resilient practices for *in situ* soil moisture conservation and drainage of excess water in heavy soils. In rainfed areas, availability of such farm implements to small and marginal farmers is important. Similarly in irrigated areas, residue management of *kharif* crops through zero till cultivation of *rabi* crops reduces the problem of burning of residues and adds to the improvement of soil health and increases water use efficiency. Custom hiring centres (CHCs) for farm implements were established in NICRA villages. A committee of farmers' manages the custom hiring centre. The rates for hiring the machines / implements are decided by the VCRMC. This committee also uses the revenue generated from hiring charges and deposits in a bank account opened in the name of VCRMC. The revenue is used for repair and maintenance of the implements and 25% share is earmarked as a sustainability fund. Different types of farm machinery are stocked in the CHCs, the most popular being zero till drill, Happy seeder, BBF planter, drum seeder, multi-crop planter, power weeder and chaff cutter. Each CHC was provided an initial sum of Rs. 6.25 lakhs for its establishment under NICRA project.

Impact of custom hiring centre

In Radouri, Yamunanagar laser land leveler from CHC was used for leveling operation by 25 more farmers during 2014-15 in 20 ha of rice-wheat system. The practice resulted in increase in rice yield (67.9 q/ha) compared to farmers practice (65 q/ha) and increased wheat yield (58.5 q/ha) compared to farmers practice (55q/ha). Water saving in rice and wheat was to the extent of 38 and 25%, respectively due to laser land leveling. Demonstration of seed drill for direct seeded basmati rice in 106 ha area covering 90 farmers was undertaken at Killi Nihal Singh village of Bathinda. Average yield of direct deeded basmati rice was 46.2 q/ha while transplanted coarse rice under late planting conditions was 44 q/ha. In the same village, farmers' usually burn rice residue prior to wheat sowing with resultant loss of soil organic matter and nutrients in addition to causing air pollution. Zero till wheat sowing with happy seeder was demonstrated in 4 ha area involving 8 farmers in 2014-15. Zero till sown wheat gave a grain yield of 50.4 q/ha with an average increase in yield by 2.9% compared to conventionally sown wheat (49 q/ha). In Morena, wheat was sown directly after harvest of short duration pigeopea using zero till seed drill in 50 ha involving 25 farmers which resulted in an increase in crop yield (50.2 q/ha) compared to 48.1 q/ha in farmers practice.

The Central Institute for Agriculture Engineering (CIAE), Bhopal demonstrated conservation agricultural machinery in 170 ha in Kachhiderekheda village. CIAE developed three machines under TDC, NICRA viz., rotary assisted bed maker-cum-seeder, straw collecting–cum-disbursing machine and raised bed seeder which are available in the custom hiring centre. Rotary assisted bed maker-cum-seeder was commercialized to M/s TAFE Chennai on 31 July, 2014 at Bhopal.

Commercialization of Rotary assisted bed maker-cum-seeder to M/s TAFE Chennai

A complete mechanization package of climate resilient practices in onion production starting from sowing, harvesting and grading prior to marketing was demonstrated in the adopted villages of the Transfer of Technology Division of the Indian Institute of Horticulture Research (IIHR). The adopted cluster comprises of villages Giriyapura, Hirenallur, Narasipura and Koratekere villages of Kadur Taluk, in Chikkamagaluru district during 2014-15. Bullock and tractor drawn onion drum seeders for sowing in flat bed and raised beds were compared in farmers' fields. A technology package comprising of raised bed planting, drip and fertigation, application of microbial consortium and foliar nutrients, pest and disease management was demonstrated in 160 ha covering 80 farmers. Results indicated increase in bulb size, shelf life and quality, reduced pest and disease incidence leading to increased productivity by 30-40%. Tractor operated onion digger for safe and quick harvesting of bulbs, and manually operated bulb grader of 2 t/h capacity were demonstrated in the village. Interface meetings, awareness and training programs were conducted in the adopted villages involving 140 farmers.

Bullock drawn onion drum seeder

Tractor drawn raised bed planter

Onion grader operated by CHC

During 2014-15, revenue generated from custom hiring centres was higher in Namakkal (Rs.103180), Ramanathpuram (Rs.54900), Kota (Rs. 54200), West Tripura (Rs.43360), Jhunjhunu (41990) and Amravati (Rs.40750). At the zonal level, revenue generated in CHCs by VCRMCs is as follows: Zone 1 (Rs 101755), Zone II (Rs 82172), Zone III (Rs 135124), Zone IV (39114), Zone V (Rs 65455), Zone VI (141780), Zone VII (42984) an Zone VIII (185790).

Monitoring and evaluation of 22 CHCs was undertaken so far to assess their performance in terms of their utility in promoting climate resilient agricultural practices and sustainability. Suggestions for better performance include: rationalization of hiring charges, regular maintenance of the implements and coordination. The CHCs played an important role in wider adoption of resource conservation technologies and resilient cropping system practices. Financial support for adding new implements and additional units of implements in demand is made available to CHCs in the XII plan.

Evaluation of CHC at Srikakulam, AP

Evaluation of CHC at West Godavari, AP

Seed bank for access to improved crop cultivars

Village level seed production of short duration, drought and flood tolerant varieties was taken up by farmers and seed societies in several NICRA villages with the technical support of KVKs in rice, soybean, foxtail millet, greengram, pigeonpea, finger millet, chickpea, wheat, rapeseed and mustard. To tackle contingency situations, increased availability of tolerant varieties was accorded priority especially in the case of paddy, soybean and foxtail millet during 2014-15. It has become a regular practice to source seed of drought tolerant and short duration cultivars from few NICRA villages as interested farmers and seed societies have taken up this as a livelihood activity. Examples include SIA 3085 and Suryanandi of foxtail millet in Kurnool, ML-365 of finger millet in Tumkur, JS-93-05 of soybean in Satna & Datia, many paddy varieties in several districts in Bihar, Jharkhand, Odisha, Chattisgarh and Valsad, Gujarat. VCRMCs facilitate seed bank activities in the village. Spread is through farmer to farmer sale as truthfully labeled seed.

Table 25: Short duration and stress tolerant varieties produced at farmer level in the village

Crop	Cultivars	Districts	No. of farmers	Area (ha)	Quantity produced (q)
Paddy	MTU-1010, Naveen, Sahbhagi, Anjali, Luit, Gitesh, Swarna sub 1, Jalashree, NDR-359, NDR-97, NLR-34449, GAR-13, JR-201	East Singhbhum, Buxur, South 24 Parganas, Saran, Chatra, Dhubri, Gonda Sonbhadra, Anantapur Valsad, Balaghat, Bilaspur, Satna	291	85	1022
Soybean	JS-9305 MAUS-71 MAUS-162	West Kameng Amravati Auranbagad Aurangabad	56	30	31
Foxtail millet	SIA 3085, Suryanandi	Kurnool	8	3	4
Cluster bean	GG-4	Anantapur	2	1	0.4
Wheat	K-9533, K-9107, JW-17	Saran, Chatra, Gonda, Satna, East Singhbhum	285	120	743
Chickpea	Jaki-9218, JG-11, 14	Amravati, Satna	16	5	32
Rapeseed & Mustard	Pusa Mahak, Pusa Tarak	Saran, Chatra, Satna	17	7.5	64

Fodder bank

In Yagantipalle village of Kurnool, green fodder shortage and dry fodder shortage is acute. Fodder bank was established in the village under NICRA project in an area of 10 acres with high yielding hybrid Napier varieties viz., APBN-1, CO-3 and CO-4. Fodder stem cuttings were supplied to farmers from this fodder bank in the village. And also the fodder was shared by 40 land less poor farmers who purchased crossbred cows. The fodder area in the village has increased from 16.18 acres in 2011 to 79.2 acres in 2015. The green fodder shortage was reduced from 86% to 36% within four years of NICRA project. In several NICRA villages in other districts seed of improved cultivars of fodder sorghum, maize, pearl millet, berseem, lucerne and oats was produced for use in regular and contingency situations. About 528 farmers participated in this activity in 148 ha area.

Fodder bank in Yagantipalle village for supply of fodder slips to farmers in Kurnool, AP

Dissemination of agro advisory services

Participating KVKs disseminated agro-advisory services using 'krishi portal', block level advisories through AICRPAM-NICRA centers and other service provider platforms such as 'Annapurna Krishi Prasar Seva' and mKrishi. Incidence of blossom end rot in tomato at fruiting stage was noticed in Rangareddy district immediately after rain following a prolonged dry spell. Farmers applied two sprays of pesticide @ Rs. 1500/ac assuming it to be a pest/disease. CRIDA-KVK issued an SMS advisory to 2500 farmers in NICRA village and the entire district to apply calcium nitrate @ 5g/l, twice at weekly interval as blossom end rot was caused due to poor uptake of calcium during soil moisture stress coinciding with fruiting stage in tomato. The advisory was adopted by 56% farmers and reduced yield loss of 30%.

Blossom end rot in tomato

4. Extreme Events

Monsoon action plans for delayed onset / deficit rainfall conditons

A monsoon action plan was prepared by 60 NICRA KVKs in many states in view of the delay in onset / deficit rainfall conditions. The impact of the contingency interventions was presented under different modules in the previous sections (3.1 to 3.4). Similarly, in view of the second stage forecast of the India Meteorological Department predicting below normal monsoon in *kharif* 2015, also 50 NICRA KVKs in drought-prone districts in 17 states prepared village level contingency plans for real time implementation depending upon the likely scenario of delay in onset of monsoon and deficit rainfall conditions experienced in the village. Contingency measures planned include demonstration of short duration and drought tolerant crop varieties, alternate crops in case of delay beyond cutoff sowing dates of normal crops, drought proofing measures related to crop, soil moisture, nutrient and water management in addition to fodder management demonstrations. NICRA KVKs have been advised to prioritize technology interventions to focus on building climate resilience and strengthening coping ability of farmers to face the unfolding aberrant monsoon situation in *kharif* 2015.

Response of NICRA-KVKs to Hudhud cyclone

Cylcone 'Hudhud' made a landfall on 12th October 2014 at Visakhapatnam and caused widespread damage to agriculture in 4 districts each in Andhra Pradesh and Odisha due to gale accompanied by downpour. NICRA KVKs at Srikakulam, West Godavari and Ganjam and ICAR research institutes visited the affected sites and issued crop advisories on adoption of contingency measures to minimize and prevent further damage in standing crops.

Paddy in various growth stages was affected due to partial or complete lodging due to high speed winds and partial inundation due to accompanying rain. Long duration crop varieties were in panicle initiation to grain filling stage while medium maturing varieties were in flowering stage. Rice at flowering stage was seriously affected. Demonstrations were taken up in NICRA villages in partially lodged crop at panicle initiation stage especially in long duration and susceptible fine rice varieties for protection against incidence of sheath blight and blast diseases and outbreak of brown plant hopper. Farmers applied urea

(25kg/ha) and MOP (10-15 kg/ha) as booster dose to long duration varieties. Some farmers applied potash at 15-20 kg while few applied foliar spray of multi-K (13-0-45) @ 10 g /l of water in medium duration paddy varieties. Advisories related to drainage, prophylactic sprays against pests and diseases, nutrient application, harvesting at physiological maturity were issued in other crops viz., oilseeds, cotton, vegetables, maize, pulses, and sugarcane. Staking, pruning, booster dose of fertilizers and prophylactic sprays were suggested in orchard crops such as coconut, banana, cashew and pulpwood plantations (Casuarina and Eucalyptus). In Odisha, farmers were alerted about the likely outbreak of swarming caterpillar and cutworm at panicle stage in late planted rice.

Paddy affected by hud-hud cyclone in Srikakulam, AP

Extensive damage in oil palm in Vishakapatnam, AP

Successful interventions that minimized crop damage due to unseasonal rains/ hailstorm in NICRA villages

Wide spread unseasonal rains over an extended period during the first week of March, 2015 adversely impacted wheat, mustard, chickpea, lentil and vegetable crops. Timely sown wheat was in grain filling to maturity stage while late sown crop was in PI to flowering stage. Timely sown wheat suffered lodging damage due to high wind velocity and water stagnation in low lying areas/fields. Other crops like gram, mustard, lentil were at flowering to maturity or harvested in case of gram at some locations. Some of the improved practices that showed advantage in minimizing the extent of damage compared to conventional practice are as follows:

- Timely sown wheat with happy seeder in combined harvested rice fields in Punjab (Fatehgar Saheb, Ropar, Faridkot and Batinda) and Haryana (Yamunanagar) escaped crop damage due to lodging or water stagnation (infiltration/percolation of water was high). Other conventionally sown fields suffered water logging up to 7 days which caused significant damage. Recovery of the lodged plants in happy seeder sown plots was faster due to less water stagnation (up to 50% recovery of affected plants in field).
- Farmers incurred an additional cost of Rs.800 per acre to harvest lodged wheat crop apart from loss in grain yield due to water logging and loss in yield of wheat straw due to poor efficiency in combine harvesting.
- Farmers incured still higher costs to harvest manually depending upon the extent of lodging due to higher labour cost. Availability of reapers helped in reducing the harvesting cost in such cases.
- In NICRA villages (north west plain zone) highly tolerant varieties of wheat (eg. WH 1105 in Yamunanagar, Haryana) suffered less damage due to yellow rust disease and saved cost of 2 sprays of fungicide. Farmers using susceptible varieties sprayed fungicide (propiconazole @ 200 ml/acre) to prevent severe incidence of yellow rust disease due to prevalence of high humidity which is favourable for the disease occurrence. Resistant varieties of wheat (HD-2967) in Punjab and HS-507, HS-420 in UP demonstrated in NICRA villages were free from yellow rust disease and farmers saved on fungicide sprays.
- Early maturing variety of gram (JG-14) demonstrated in NICRA villages in MP (Balaghat district) escaped damaged due to unseasonal rain (90 mm).
- Early maturing variety of mustard NRC-BR2 demonstrated in NICRA village (Kota) (30 ha, variety is 7 days early), escaped damage due to unseasonal rains in March first week as it was harvested by February last week.
- Most of the farmers drained out excess water from their fields and minimized the extent of damage especially in wheat and vegetable crops.

- Vegetable (brinjal, tomato, cabbage, cauliflower, carrot, Chillies, onion), pea, lentil and mustard farmers sprayed fungicides (mancozeb @ 2 g/liter, carbendazim @ 1 g/liter, copper oxichloride (COC) @ 3 g/liter, steptocycline sulphate @ 1 g/10 liters) for the control of foliar diseases such as leaf spot, blight, mildews & fruit rot and minimized further damage due to coincidence of favourable weather conditions triggered by the unseasonal rains. In vegetables and mustard crop, aphid incidence was managed with sprays of dimethoate @ 1 ml/liter or imidacloprid @ 0.3 ml/liter.
- Furrow irrigated raised bed planted wheat in NICRA village (10 ha) suffered significantly less damage due to line sowing and wider spacing due to the hail storm that occurred in Kota, Rajasthan. Conventionally sown wheat suffered 70% damage in the village.

5. Village Level Carbon Balance Studies

Though agriculture is one of the contributors of GHG emissions, its potential to sequester carbon and mitigate the emissions is widely reported. Besides enhancing the adaptive capacity of crops and cropping systems, climate resilient practices bring about mitigation as a co-benefit of adaptation and contribute positively to the carbon balance. A study is underway on quantifying the effect of various climate resilient interventions on carbon balance in NICRA villages using the Ex-Ante Carbon Balance Tool (EX-ACT) developed by FAO. During 2014-15, carbon balance assessment was completed in NICRA KVKs in two zones and the data collection is in progress in two more zones.

Data was collected from three NICRA villages in Gujarat and four in Rajasthan (representing Zone VI) on resilient practices demonstrated and extent of adoption. Data was collected in structured formats and compared with village baseline information. EX-ACT model was run using the data and carbon balance was quantified.

The overall carbon balance resulting from the climate resilient interventions ranged from -1621 to -10410 t CO_2 eq indicating potential for mitigation through agriculture and allied sectors. This indicates mitigation of GHG emissions and sequestration of carbon from the atmosphere into the vegetation and soil. Highest mitigation of -10410 t CO_2 eq was observed in Magharvada village of Rajkot district followed by Bharu village of Jhunjhunu district. In Magharvada village the major contribution for mitigation was from annuals (-10393 t CO_2 eq) and fertilizer management (-6645 t CO_2 eq). Mitigation in Bharu village majorly resulted from annuals (-9001 t CO_2 eq) followed by fertilizer management (-681 t CO_2 eq).

Though all the villages have shown overall mitigation from the interventions, Sitara and Bhalot have shown lowest potential of -1621 t CO_2 eq and -2128 t CO_2 eq, respectively. Major emissions in Sitara village resulted from livestock (1014 t CO_2 eq) and non-forest land use changes (427 t CO_2 eq). Whereas non-forest land use change (7098 t CO_2 eq) was found to be the highest contributing component followed by livestock (1727 t CO_2 eq) component in Bhalot village.

In case of Zone VIII, preliminary data regarding the adoption of interventions was collected. Model was run for all the four KVKs (of Karnataka) from the initial data received and formats were sent to all the KVKs for the missing data. Model was run and the C balance was computed for the four villages.

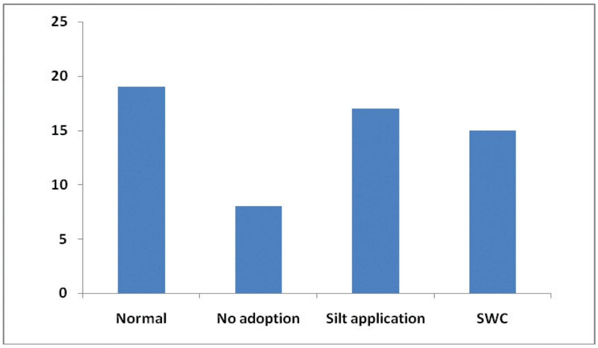
In case of zone –II and III, basic data was received from 30 villages representing 28 KVKs. Model was run with the basic data, missing data was identified and intimated to all the KVKs from zone II and III. Carbon balance will be computed after obtaining the necessary data.

In case of Zone-IV, model was run for all the KVKs using basic data (except for Maharajgunj and Khushinagar). Formats were prepared and sent to all KVKs. Complete data was received from Gonda and Chitrakoot KVKs and completed the C balance for these two KVKs. In case of Zone-I comprising states of Haryana and Himachal Pradesh, model was run with the basic data received from Yamunanagar and Sirsa of Haryana and Hamirpur and Kullu of Himachal Pradesh. Formats were prepared for the missing data for completion of the study for these KVKs.

6. Resilience Indicators for Adaptation Interventions

The impact of various adaptation interventions on economics and resilience was also examined at Baramati, Pune district. It was observed that the adaptation intervention in the form of application of silt and in situ moisture conservation measures protected yield of sorghum during the drought. Resilience was measured as the ratio of yield obtained with adaptation to that obtained in normal conditions. A higher ratio indicates higher resilience. These two adaptation interventions gave 85 and 78% of normal yield and were proved to enhance resilience. With no adaptation intervention, only 48% of normal yield was obtained. With respect to profitability, adaptation interventions ensured that more than 70% of normal income was obtained showing a considerably high income resilience. In case of no adaptation, farmers hardly recovered their variable costs indicating their vulnerability. Another major finding is the observation that income resilience is more when the livelihoods are more diversified. However, the analysis also hinted at possible lower income with more diversification in 'normal' years.

Interaction with farmers in Jalgaon KP village, Baramati, Maharashtra



Effect of adaptation interventions on sorghum yield during drought, Baramati, 2014-15

7. Convergence with Line Departments

A number of interventions were taken up by NICRA KVKs during the year in convergence with developmental programs which are operational at the village level. Support from these developmental programs was used for scaling up of proven interventions in the village. In case of NRM, support was mobilized for various water harvesting structures, recharge structures, micro irrigation systems, polythene lining of farm ponds, deepening of drainage channels, distribution of green manuring seed to large number of farmers, tree planting including horticulture, etc. In crop production, convergence with line departments was used for increasing the spread of HYV of food crops, promotion of cultivation practices such as SRI, Direct Seeded Rice in various states. In case of animal husbandry, interventions such as animal vaccination camps, and health camps, timely availability of medicines, large scale production and availability of improved fodder crop seed, planting material and material for silage making were taken up in convergence. Capacity building of the farmers in NICRA villages was also taken up in convergence in the form of trainings and exposure visits as part of the ongoing programs. Efforts were made to enhance the coverage of the interventions in the village with the support of the line departments through convergence. Linkages were also established with the dryland missions of various state governments and in centrally sponsored schemes such as MGNREGA, NFSM, NHM, BGREI, RKVY, etc.

Table 26: Convergence with ongoing schemes

KVK / District	Organizations	Interventions
Nalgonda, Kutch Ahmedanagar, Amravati, Baramati, Gumla, Kodarma, Chatra, Lunglei, Phek, Senapati, Chitrakoot, Kushinagar, Dantewada, Belgaum, Villupuram	MGNREGA, IWDP, NHM Andhra Pradesh Micro Irrigation Project, GGRC Agriculture Department	Drip, farm ponds, *in situ* soil & water conservation practices, check dam, farm bunding, jalkund, land levelling
Kodarma. Mokokchung	State Departments of Agriculture	Improved seed of pigeonpea and SRI cultivation

KVK / District	Organizations	Interventions
Malda, Dibrugarh, East Sikkim, Mokokchung, Ri-bhoi, West Garo Hills, Cachar, Gorakhpur, Kota, Belgaum, Kolar	State Departments of Agriculture, Animal Husbandry and Fisheries	Animal health camp, preventive vaccination, deworming, improved breeds, fingerlings, fish ponds, mineral mixtures
Muzzafarnagar, Gorakhpur, Nalgonda	District Agriculture department	Seed of green manuring crops and vegetables
Bhagapat, Tumkur	State Agriculture Department, IFFCO, Forest department	Vermicompost, tree seedlings
East Sikkim. Lunglei	ATMA	Training programs, exposure visits

NICRA villages serve as learning sites for farmers and state department officials through on-site visits

8. Monitoring and Evaluation of TDC

Zonal Monitoring Committees (ZMCs) constituted separately for each zone to monitor and review the progress in technology demonstration component visited 36 NICRA KVKs during the period April, 2014 to March, 2015 under Zone I (4 KVKs), Zone II (6 KVKs), Zone III (5 KVKs), Zone IV (11 KVKs), Zone VI (3 KVKs), Zone VII (3 KVKs) and VIII (4 KVKs).

Table 27: NICRA KVKs monitored by ZMCs during 2014-15

Zone	State	NICRA-KVK	Date of visit
Zone I	Himachal Pradesh	Kinnaur	9 Sept, 2014
		Chamba	9 Sept, 2014
		Kullu	11 Sept, 2014
		Hamirpur	11 Sept, 2014
Zone II	Jharkhand	Chatra	12 March 2015
		Palamu	13 March 2015
		Gumla	14 March 2015
	Bihar	Jehanabad	20 May, 2015
		Buxar	21 May, 2015
		Saran	22 May, 2015
Zone III	Assam	Sonitpur	23 June, 2014
		Dhubri	24 June, 2014
		Dibrugarh	27 June, 2014
	Meghalaya	Ri-Bhoi	25 June, 2014
	Arunachal Pradesh	Tirap	28 June, 2014
Zone IV	Uttar Pradesh	Bahraich	14 April, 2014
		Gonda	14 April, 2014
		Chitrakoot	15 April, 2014
		Hamipur	19 Feb, 2015
		Jhansi	20 Feb, 2015
		Sonbhadra	16 Mar, 2015
		Gorakhpur	17 Mar, 2015
		Kushinagar	17 Mar, 2015
		Maharajganj	18 Mar, 2015
	Uttarakhand	Tehri Gharwal	23 Mar, 2015
		Uttarkashi	24 Mar, 2015

Zone	State	NICRA-KVK	Date of visit
Zone VI	Gujarat	Kutch	29 Sept, 2014
		Valsad	30 Sept, 2014
		Rajkot	1 Oct, 2014
Zone VII	Madhya Pradesh	Satna	19 Jan, 2015
		Chattarpur	20 Jan, 2015
		Tikamgarh	21 Jan, 2015
Zone VIII	Karnataka	Davangere	20 Feb, 2015
		Tumkur	21 Feb, 2015
		Belgavi	22 Feb, 2015
		Chickballapur	23 Feb, 2015

ZMC teams interact with farmers in NICRA villages in Zone VI and VIII

Review cum Action Plan Preparation Workshops

Zonal workshops at all the 8 Zonal Project Directorates were conducted during April - May, 2015 to review the progress in 2014-15. The meetings captured the salient achievements and success stories from technology demonstrations in 100 NICRA adopted villages. Each NICRA KVK also presented the action plan for 2015-16 giving the details of climate resilient agricultural practices and their extent of coverage (area and number of farmers).

Review workshop (2014-15) at ZPD, Zone II, Kolkata

9. Capacity Development Programs

Capacity Development Program on Climate Resilient Agriculture

ICAR-CRIDA organized 8-day capacity development program for KVK Staff in four batches during 19-31 January, 2015 in which 205 participants including Program Coordinators, Subject Mater Specialists and Research Fellows from 100 NICRA-KVKs in eight Zonal Project Directorates (ZPDs) implementing TDC-NICRA project participated. Multidisciplinary staff were brought together in four batches to facilitate interaction and cross learning on successful interventions for climate resilience in agriculture. The capacity development program was undertaken based on the recommendation of Zonal Monitoring Committees. Knowledge updating on various aspects covered value added agromet advisories, principles, data formats and quantification of impact of climate resilient practices and technologies in natural resource management, crop production, livestock production systems and also on strengthening village level institutions for seed bank and custom hiring centres for farm machinery. Best performing NICRA-KVKs and KVKs hand holding Village level Climate Risk Management Committees (VCRMC) in each zone shared their experiences by presenting the best practices, their impact and farmers feedback in adopted NICRA villages. All the KVKs participated in the poster sessions on successful interventions vis-a-vis climate vulnerability faced in the adopted village. Participants visited state-of-the-art climate change research facilities on phenomics, OTCs, GHG measurements and livestock interventions established at CRIDA under NICRA.

Capacity Development of NICRA-KVK Scientists at ICAR-CRIDA

9.1. Training Programs Conducted

Table 28: Theme-wise training programs conducted by NICRA KVKs

Thematic Area	No. of Courses	Total
Crop diversification	17	1063
Crop management	249	9562
Farm implements & machinery	53	1981
Livestock management	139	5269
NRM	118	4349
Nutrient management	91	3438
Resource conservation technologies	55	2225
TOTAL	722	27887

9.2. Dissemination Activities

Extension Programs organized by ICAR-NEH

ICAR-NEH organized a day-long *awareness-cum-ranching program* of Pengba (*Osteobrama-belangeri*) fish species of Northeast India in Umiam Lake of Barapani on 5th September, 2014 under NICRA Project. The objective of this program was to create awareness and promote culture of this endemic herbivorous indigenous species of Manipur under the agro-climatic condition of the state of Meghalaya which has high market value for its taste. The occasion was chaired by Dr. S.V. Ngachan, Director and Mrs. I.R. Sangma, Director, Department of Fisheries, Govt. of Meghalaya as the Chief Guest for the program. ICAR scientists along with more than 30 fish farmers from Mysiem, Phyllon and Nongthymmai villages participated in the program.

Awareness program on climate resilient agriculture organized by ICAR-NEH

ICAR NEH organized an awareness program on climate resilient agriculture and to make large scale campaign for implementation of contingency plans for adaptation to climate change on 2nd August, 2014. Scientists of ICAR-RC-NEH Region highlighted suitable adaptation and mitigation strategies for addressing the problems in farmers' fields due to scanty rainfall in the region. A contingency plan was prepared to tackle weather aberrations and disseminated to all stakeholders through SMS using Kisan Portal. More than 100 farmers from different villages of the state participated in the program. Some critical inputs such as planting material and mineral supplements kits were made available for demonstrations to farmers to face the drought like situation.

National Dairy Research Institute (NDRI), Karnal

TOT Division of NDRI organized two veterinary health camps in Dilawara & Suhana villages and exposure visit of 100 famers to National Dairy Mela in February, 2015. Two awareness camps were organized on safe dung disposal and detection of heat symptoms in dairy animals involving 36 farmers from NICRA villages.

IARI, New Delhi

Twenty five training programs were organized to upgrade the knowledge and skills of the farmers in direct seeded rice (DSR) and zero-till wheat cultivation systems; management of nematode, weeds and nutrient management in DSR, Integrated Pest Management (IPM) in paddy and vegetables, use of leaf colour chart in paddy and wheat, use of bio fertilizers in DSR and use of mKRISHI for mobile based advisory. Field days (15) and kisan gosthies (10) were also organized to resolve the queries of farmers.

Soil health cards were prepared and distributed among 34 farmers of Mumtajpur and Lokra villages to make recommendations to farmers on application of fertilizers, nutrients and other soil amendments based on soil test report.

A farmers' workshop on direct seeded rice was organized to facilitate cross-learning about the precise management of DSR technology. Sharing of experiences by about 110 participants (90 farmers and 20 scientists and extension professionals) helped the farmers of NICRA village understand the critical stages of weed and nutrient management for successful application of DSR technology.

Farmers - Scientists interaction workshop on DSR in irrigated agroecosystems

CIAE, Bhopal

Extension activities such as trainings, farm visits and interaction meetings were organized during 2014-15 in the adopted village and more than 400 farmers participated in the programme. Economic impact of broad bed planter demonstration was assessed in Kachhiberkheda village during *kharif* and *rabi* seasons and it was observed that the net income of farmers increased by 56.6 and 27.4 percent in soybean and wheat crop respectively. Nine training programs involving 419 farmers in conservation agricultural machinery, raised bed technology, protective vegetable cultivation, drudger is reduction in farm women by using farm implements, kitchen gardening and exposure visits were organized by CIAE, Bhopal in Kachhiberkheda village.

CMFRI, Kochi & Karwar

Technology demonstration activities were carried out at Veraval, KVK Cochin and Karwar centres of CMFRI. At Veraval "*Awareness programme on Climate Change and Gujarat Fisheries*" was conducted where knowledge was imparted to fishermen, stakeholders, and researchers. Vulnerability of the coastal fisher folk was assessed at district level and based on the results, one day *"Fish-farmer awareness meet*" was organized at Navabunder, where basic knowledge was given to the fishermen regarding climate change and how to sustain the adverse effects of climate change through various adaptation and mitigation options. The results of the study were also shared with them and the issues pertaining to their problems related to fisheries were also addressed. Leaflets/ pamphlets on open sea cage farming were distributed to generate more awareness. Surveys were also initiated related to "*carbon foot-printing from house hold and mariculture"* and "*role of women in fisheries*" along the northwest coast; both the surveys were successfully completed.

Participatory programs with the help of state government of Goa are being carried out actively by Karwar research Centre of CMFRI. Fishermen groups were identified from different areas of Goa and Karwar and trainings and awareness programs were given. Cage farming of cobia, pompano and seabass was carried out and demonstrated with the technical support and consultancy of KRC of CMFRI. At Cochin, Integration of Scientific fin fish farming along with traditional Pokkali paddy were undertaken. CMFRI conducted 19 capacity building programs for 285 fish farmers on cage farming of Cobia, Seabass, Pompano, Finfish and Shellfish.

CRIDA-KVK, Hyderabad

CRIDA-KVK organized 3 field days on mulching techniques in vegetables and shade net nursery for production of quality seedlings involving 112 farmers in NICRA village. A training program was conducted on animal health management in which 72 farmers participated.

Table 29: Summary of extension activities and their coverage under NICRA-TDC

Activity	Number organized	Farmers (No.)
Awareness programs	283	8263
Exposure visits of farmers	80	1921
Field days in NICRA villages	285	6552
Grand Total	648	16736

Video documentation of climate resilient interventions

Video documentation of successful climate resilient interventions demonstrated under NICRA was initiated during 2014-15. Farmers in the villages shared their experiences in addressing climate variability through successful interventions. Four regional films both in Hindi and English and one film at the National level are being produced.

Capturing climate resilient intervention in action

10. Awards and Recognitions

NICRA farmers awarded on CRIDA Foundation Day

Best NICRA KVK Awards

The Best NICRA KVK in each Zone was awarded a certificate and a grant of Rs.1.00 lakh in recognition of the collective efforts of KVK in implementing climate resilient practices & technologies. The NICRA KVKs are Faridkot (Zone I), Gumla (Zone II), West Garo Hills (Zone III), Gonda (Zone IV), Amravati (Zone V), Valsad (Zone VI), Datia (Zone VII), & Namakkal (Zone VIII).

Zone I

Zone II

Best NICRA KVK awards (2011-14) in different Zones (Zone I to II)

Zone III

Zone IV

Zone V

Zone VI

Zone VII

Zone VIII

Best NICRA KVK awards (2011-14) in different Zones (Zone VI to VIII)

11. Conferences / Workshops / Meetings

ICAR-DAC interface meeting on NICRA-NMSA

NRM Division of ICAR organized ICAR-DAC interface meeting on National Innovations in Climate Resilient Agriculture (NICRA) - National Mission on Sustainable Agriculture (NMSA) on 13th October 2014. Scope for upscaling of various drought proofing technologies that were identified under Technology Demonstration Component and AICRP on Dryland Agriculture (AICRPDA) was discussed. NMSA which is one of the eight Missions under the National Action Plan on Climate Change (NAPCC), seeks to address issues regarding sustainable agriculture in the context of risks associated with climate change through appropriate adaptation and resilient practices for ensuring food security, enhancing livelihood opportunities and contributing to economic stability at the national level. Successful interventions developed in NICRA will be taken forward through NMSA so that climate resilient technologies can reach a large number of farmers. Dr. Y.G. Prasad, PI, NICRA-TDC and Dr. Ch. Srinivasa Rao, Director, ICAR-CRIDA presented the successful interventions under TDC and CRIDA-AICRPDA system, respectively in the the meeting chaired by Dr. A.K. Sikka, DDG, NRM and Shri R.B. Sinha, Joint Secretary, Ministry of Agriculture and Mission Leader of NMSA, and participated by officials from NFSM, Zonal Project Directors of various Zones, Scientists of CRIDA, NICRA team and NRM division of ICAR. The main outcome of the meeting was theme-wise identification of climate resilient practices and technologies along with recommended domain, specifications/ design, cost and anticipated benefits. A timely publication on 'Compensatory *rabi* production plan for 2014' was released in the workshop.

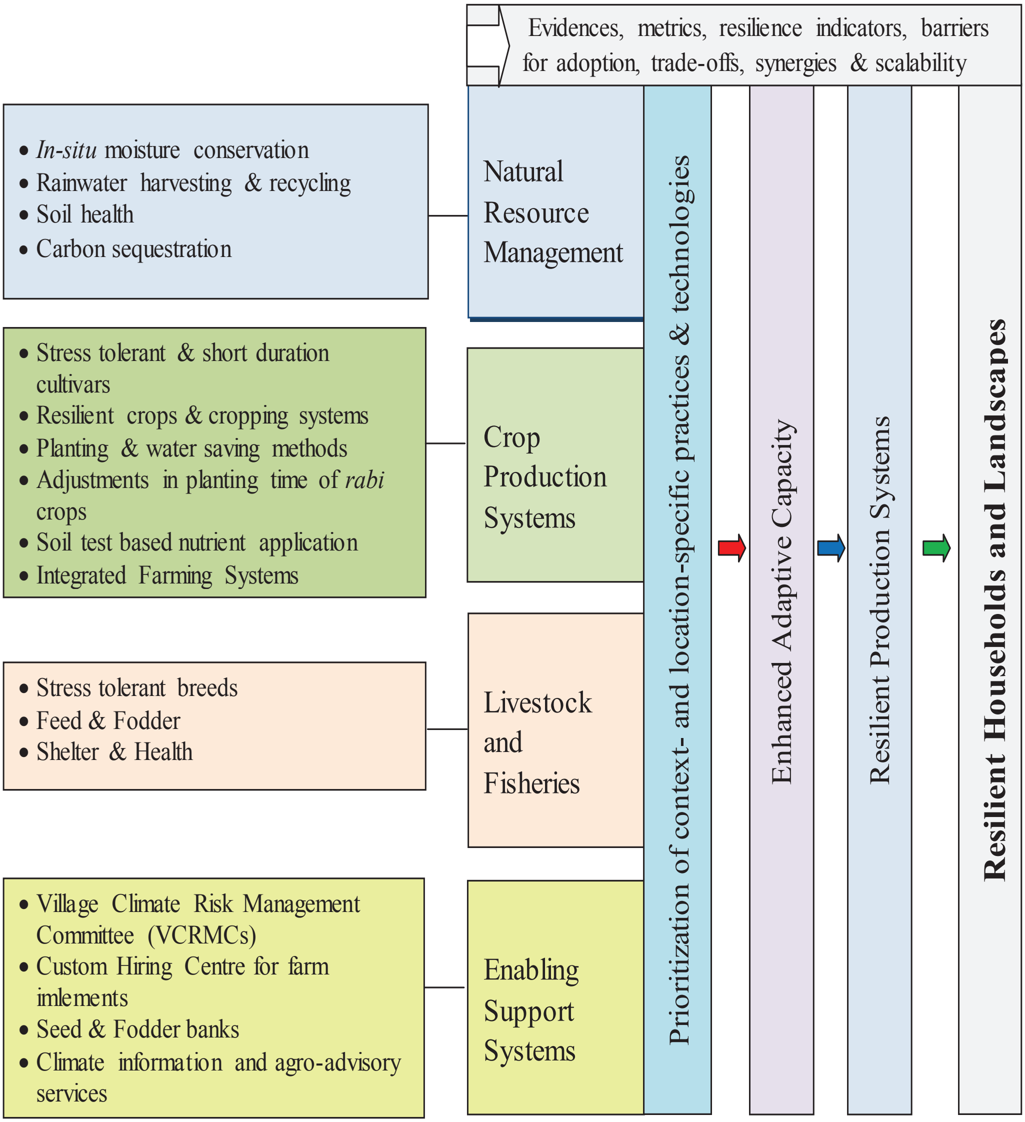
ICAR-DAC interface meeting on NICRA-NMSA

Release of publication on 'Compensatory *rabi* production plan'

Brainstorming Workshop on Climate Resilient Villages Framework at CRIDA

CRIDA, Hyderabad organized a brainstorming workshop on climate resilient villages (CRVs) on 29 November, 2014. The aim of the workshop was to share the experiences on successful climate resilient practices among stakeholders implementing projects in agriculture addressing climate change. The workshop brought together different stakeholders working towards climate resilient agriculture for cross-fertilization of ideas, innovations, processes and delivery mechanisms and to evolve a broad framework for climate resilient villages. The workshop was inaugurated by Dr. Alok Sikka, DDG (NRM) with lead presentations from Dr. B.M. Prasanna, Director, Global Maize Program, CIMMYT, Prof. Whitbread, Program Leader, ICRISAT, Dr. M.L.Jat, Cropping Systems Agronomist, CIMMYT-CCAFS, Sri Ajay Shelke of WOTR, Pune, Sri Dineesh kumar Singh, TCS. The lead presentations were followed by focus group discussions on components of climate resilient villages such as natural resource management, crop production systems, livestock and fisheries production systems and institutional mechanisms. Dr. N.H. Rao, Dr. M. Maheswari, Dr. Shalander Kumar and Dr. S. Dixit moderated the group discussions. Dr. Ch. Srinivasa Rao, Director, CRIDA was the Co-Chair, Zonal Project Directors Dr. S. Dixit, Zone VIII; Dr. S. Prabhu Kumar, Zone I; Dr. R. Sudhakar, Zone V & Dr. Atar Singh, Zone VII and Nodal Officers of NICRA at ZPDs, Program Coordinators of KVKs participated. Dr. Y.G. Prasad, Coordinator, Technology Demonstration Component and J.V.N.S Prasad, Co-PI organized the workshop. A framework for CRV was developed as an output of the workshop.

Brainstorming workshop on Climate Resilient Villages



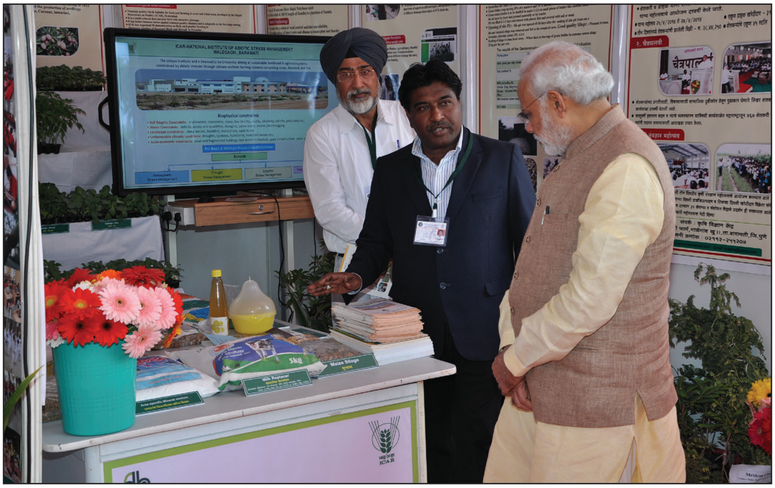
Framework for CRV

Orientation Workshop for 21 new NICRA KVKs

In addition to the 100 existing NICRA KVKs, technology demonstration component of NICRA will be implemented in 21 new districts as approved in the XII Plan. An Orientation Workshop was organized on 30th April, 2015 at ICAR-CRIDA, Hyderabad to guide the new KVKs on the implementation of technology demonstrations for climate resilience in agriculture in identified villages. The workshop was chaired by Dr. Ch. Srinivasa Rao, Director, CRIDA with participation by Zonal Project Directors of Zone III and Zone V and PI, NICRA. Dr. Y.G. Prasad, PI, NICRA-TDC presented a step by step guidance from selection of villages, launching of the project, establishing a baseline through participatory rural appraisal and focus group discussions, formulation of village climate risk management committee, setting up of custom hiring center for farm implements and action plan preparation for 2015-16.

Orientation workshop for 21 new NICRA KVKs
at ICAR-CRIDA, Hyderabad

12. Distinguished Visitors



Hon'ble Prime Minister, Shri Narendra Modi at the NICRA exhibition stall at Baramati on 14-2-2015

Governor of West Tripura visits NICRA KVK, West Tripura on 4-2-2015

Shri Sharad Pawar former Union Minister of Agriculture visits demonstration site of *in-situ* moisture conservation and interacts with farmers in NICRA village at Baramati on 20-10-2014

Shri R. Rajagopal, Additional Secretary, DARE & Secretary, ICAR visits NICRA village in Namakkal on 9-2-2015

Smt. Kamaladevi, Deputy Director, Planning Commission visits NICRA village Jalgaon (KP), Baramati on 24-02-2015

Dr. A.K.Sikka, DDG (NRM) visits NICRA village, Rasidpur, Ropar on 11-01-2015

13. Publications

Prasad, YG., Maheswari, M., Dixit, S., Srinivasarao, Ch., Sikka, AK., Venkateswarlu, B., Sudhakar, N., Prabhu Kumar, S., Singh, AK., Gogoi, AK., Singh, AK., Singh, YVand Mishra, A. 2014. Smart Practices and Technologies for Climate Resilient Agriculture. Central Research Institute for Dryland Agriculture (ICAR), Hyderabad. 76 p.

NICRA 2015. Monsoon Action Plan - 2015: Village Level Contingency Plans for Climate Resilience in Agriculture (Y.G. Prasad and J.V.N.S. Prasad, eds.). Technology Demonstration Component, National Innovations in Climate Resilient Agriculture (NICRA), ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-pp.54.

NICRA report 2014. Annual report 2013-14 of Zone V (G. Rajender Reddy, N. Sudhakar, K. Dattatri, Chari Appaji, J.V. Prasad, A.R. Reddy, eds.). Zonal Project Directorate (Zone-V), Hyderabad. 107 p.

NICRA report 2014. Annual report 2013-14 of Zone VI (Y.V. Singh, P.P. Rohilla, M.S. Meena, P.K. Satapathy, B.L.Kumawat, eds.). Zonal Project Directorate, Zone-VI, CAZRI Campus, Jodhpur. Rajasthan. 290 p.

NICRA report 2014. Annual Report 2013-14 of Zone VII (S.R.K. Singh and A. Mishra, eds.). Zonal Project Directorate, Zone VII, ICAR, Jabalpur. 87 p

NICRA report 2014. Action plan 2014-15 (K.D. Kokate, S.R.K. Singh and A. Mishra, eds.) Zonal Project Directorate (Zone-VII), Jabalpur. 170 p.

14. Contributors – NICRA KVKs

S. No.	KVK / District	State	Crops	Soil	Rainfall (mm)	Name of the Program Coordinator
Zone I						
1.	Sirsa	Haryana	Rice, Wheat, Cotton and Sorghum	Sandy loam	300	L.S. Beniwal
2.	Yamu-nanagar	Haryana	Wheat	Sandy loam	1107	B.R.Kamboj
3.	Chamba	Himachal Pradesh	Maize, Wheat and Apple	Sandy loam	1590	Rajiv Raina
4.	Hamirpur	Himachal Pradesh	Wheat, Maize and Chickpea	Sandy clay loam	1025	Anand Singh
5.	Kullu	Himachal Pradesh	Maize, Wheat and Blackgram	Coarse loamy	919	Surinder Kumar Thakur
6.	Kinnaur	Himachal Pradesh	Maize, Barley, Rajmash, Pea and Apple	Sand to loamy sand	672.2	Manohar Lal Verma
7.	Kathua	Jammu & Kashmir	Maize and Wheat	Sandy loam	1167.5	Amrish Vaid
8.	Pulwama	Jammu & Kashmir	Paddy and Apple	Silty clay loam	305.1	Midgal
9.	Bathinda	Punjab	Paddy, Wheat and Cotton	Loamy	292	Jagdish Grover
10.	Fatehgarh Sahib	Punjab	Rice and Wheat	Loam/ sandy loam	877	G.P.S. Sodhi
11.	Faridkot	Punjab	Paddy, Wheat, Cotton and Mustard	Sandy loam & clay loam	433	Amrit Pal Singh
12.	Ropar	Punjab	Rice, Wheat and Poplar	Sandy loam	750	Harinder Singh
Zone II						
13.	Port Blair	A & N Island	Paddy and Coconut	Clay loam	3100	Nagesh Ram
14.	Aurangabad	Bihar	Paddy, Wheat, Lentil, Chickpea and Mustard	Clay loam	1150	Nityanand

S. No.	KVK / District	State	Crops	Soil	Rainfall (mm)	Name of the Program Coordinator
15.	Buxar	Bihar	Rice and Wheat	Clay and loamy	891.2	Deo Kiran
16.	Jehanabad	Bihar	Paddy, Wheat, Lentil and Redgram	Clay loam	952	Shobha Rani
17.	Nawadah	Bihar	Pigeonpea, Paddy, Maize, Chickpea and Wheat	Sandy loam	1037	S.K. Mishra
18.	Saran	Bihar	Paddy, Wheat, Maize, Pigeonpea and Potato	Sandy loam	1140	Ratnesh Kumar Jha
19.	Supaul	Bihar	Paddy, Wheat, Greengram and Maize	sandy loam	1450	Manoj Kumar
20.	Chatra	Jharkhand	Paddy, Maize, Pigeonpea and Wheat	Sandy loam	810	Ranjay Kumar Singh
21.	East Singhbhum	Jharkhand	Rice and Chickpea	Sandy loam	1750	Artibeena Ekka
22.	Gumla	Jharkhand	Paddy, Maize, Blackgram, Groundnut, niger and Wheat	Sandy loam and clay loam	1450	Sanjay Kumar
23.	Koderma	Jharkhand	Paddy, Pigeonpea, Maize and Wheat	Sandy loam	1193	Vinay Kumar Singh
24.	Palamau	Jharkhand	Paddy, Maize, Pigeonpea, Wheat, Blackgram and Chickpea	Sandy loam/ clay loam	1257	Lalit Kumar Das
25.	Coochbehar	West Bengal	Rice, Wheat, Mustard, Potato and Jute	Coarse textured acidic soils	2983	Sanjay Das
26.	Malda	West Bengal	Maize, Black gram, Wheat, Mustard and Jute	Loamy to sandy loam	1453	P.K. Gangopad-hyaya
27.	South 24 Paraganas	West Bengal	Paddy	Clay and silty clay	1750	Nilendu Jyoti Maitra

S. No.	KVK / District	State	Crops	Soil	Rainfall (mm)	Name of the Program Coordinator
Zone III						
28.	Tirap	Arunchal Pradesh	Rice, Maize, Proso and foxtail millet and Toria	Sandy loam and clay loam	2505.6	D.S. Chhonkar
29.	West Kameng	Arunchal Pradesh	Maize, Fieldpea, Soybean, Rajmash and Paddy	Sandy	1704.8	N.D. Singh
30.	West Siang	Arunchal Pradesh	Paddy, Maize and Organge	Silty clay loam	1906	A. Kiran Kumar Singh
31.	Cachar	Assam	Rice, Potato and Rajmash	Clay	3181	Pranabjyoti Sarma
32.	Dibrugarh	Assam	Rice and Toria	Sandy loam and clay loam	2000	H.K. Bhattacharya
33.	Dhubri	Assam	Rice and Toria	Sandy loam, clay loam and clay	3280	Chinmoy Kumar Sarma
34.	Sonitpur	Assam	Rice, Toria, Sugarcane and Vegetables	Sandy, loamy sand and sandy loam	1940	Pramod Chandra Deka
35.	Imphal East	Manipur	Paddy, Rapeseed Mustard, Green Pea and Potato	Alluvial	1592	T. Medhabati Devi
36.	Senapati	Manipur	Paddy, Maize, Soybean, potato, Fieldpea and Toria	Clay and sandy loam	1166	N. Jyotsna
37.	Umaim	Meghalaya	Paddy, ginger and turmeric	Red loamy soil, sandy loam	2400	S.Baishya
38.	West Garo Hills	Meghalaya	Paddy, Areca and Cashew	Red sandy loam soil	4003	Tanmay Samajdar
39.	Lunglei	Mizoram	Rice and Maize	Alluvial	2098	Lalmuanzovi

S. No.	KVK / District	State	Crops	Soil	Rainfall (mm)	Name of the Program Coordinator
40.	Dimapur	Nagaland	Rice, Maize and Mustard	Sandy loam	1657	Anamika Sharma
41.	Mokok-chung	Nagaland	Paddy, Maize and Cucumber	Non lateritic red, alluvial and forest soils	1408	Pijush Kanti Biswas
42.	Phek	Nagaland	Paddy, Maize and Pea	Clay, Alluvial and Non Laterite Red Soil	1550	R.K. Singh
43.	East Sikkim	Sikkim	Paddy, Maize, Fingermillet and Ginger	Sandy loam	3800	A.K. Mohanty
44.	West Tripura	Tripura	Paddy, Maize, Bitter Gourd and Potato	Red loamy to sandy loam	2035	Dipak Nath
Zone IV						
45.	Bahraich	Uttar Pradesh	Paddy, Wheat, Lentil and Toria	Sandy loam	900	Om Prakash Verma
46.	Bhagpat	Uttar Pradesh	Paddy, Wheat, Mustard and Sugarcane	Loam to Sandy loam	750	Gajendra Pal
47.	Chitrakoot	Uttar Pradesh	Paddy, Chickpea, Wheat, Lentil, Barley and Pigeonpea + Sorghum	Silty clay	542	Narender Singh
48.	Gorakhpur	Uttar Pradesh	Rice, Groundnut, Wheat, Lentil and Mustard	Sandy loam	1211	Sanjit Kumar
49.	Gonda	Uttar Pradesh	Paddy, Sugarcane, Wheat and Pigeonpea	Alluvial	1431	U.N.Singh

S. No.	KVK / District	State	Crops	Soil	Rainfall (mm)	Name of the Program Coordinator
50.	Hamirpur	Uttar Pradesh	Chickpea, Wheat, Sesame, Pigeonpea, Mustard and Lentil	Kabar, maar	864	C.K. Rai
51.	Jhansi	Uttar Pradesh	Wheat, Groundnut and Blackgram	Red & Black	885	Nishi Roy
52.	Kushinagar	Uttar Pradesh	Paddy, Wheat, Sesame and Lentil	Sandy loam	1282	Akhilesh Kumar Dubey
53.	Maharajganj	Uttar Pradesh	Rice, Wheat and Lentil	Alluvial	880	V.P.Singh
54.	Muzaffar-nagar	Uttar Pradesh	Sugarcane, Wheat, Blackgram, Sorghum and Mustard	Sandy loam to clay loam	670	P.K. Singh
55.	Sonbhadra	Uttar Pradesh	Paddy, Wheat, Lentil, Chickpea and Pigeonpea	Black	1035	S.K.Singh
56.	Tehri Gharwal	Uttarakhand	Wheat, Pea, Soybean, Fingermillet and Barnyard millet	Brown black, forest soil	1230	Laxmi Ravat
57.	Uttarkashi	Uttarakhand	Wheat, Paddy, Fingermillet, Barnyard millet and Lentil	Sandy loam	1560	V.K. Sachan
Zone V						
58.	Ananatapur	Andhra Pradesh	Groundnut + Redgram, Redgram and Rice	Red (75%); Black (25%)	602	P. Laksmi Reddy
59.	Kurnool	Andhra Pradesh	Pigeonpea, Paddy, Cotton, Sunflower, Chickpea and Sorghum	Sandy clay loam to clay loam	546.4	G. Dhana-lakshmi
60.	Srikakulam	Andhra Pradesh	Paddy, Greengram, Blackgram, Sesame and Groundut	Red sandy and sandy loam	1200	D.Chinnam Naidu

S. No.	KVK / District	State	Crops	Soil	Rainfall (mm)	Name of the Program Coordinator
61.	West Godavari	Andhra Pradesh	Paddy	Alluvial	1185	C. Venkata Reddy
62.	Amravati	Maharashtra	Soybean, Cotton, Pigeonpea, Wheat and Chickpea	Medium Black	877	K.A. Dhapake
63.	Aurangabad	Maharashtra	Cotton, Maize, Pearl millet, Wheat and Chickpea	Shallow & light	644.3	S.B. Pawar
64.	Ahmed-nagar	Maharashtra	Pearlmillet, Soybean, Wheat and Chickpea	sandy loam	425	Bhaskar Gaikwad
65.	Baramati	Maharashtra	Sorghum, Wheat, Maize, Pearl millet and Chickpea	Medium black	524	R.S. Jadhav
66.	Nandurbar	Maharashtra	Sorghum, Maize, Soybean, Blackgram and Cotton	Red and black	813	R.S. Dahatonde
67.	Buldana	Maharashtra				Nitin Gupta
68.	Ratnagiri	Maharashtra	Rice, Fingermillet and Proso millet	Red lateritic soil	3594	Sudesh Kumar Chavan
69.	Khammam	Telangana	Paddy, Cotton, Chilli and Redgram	Black cotton and red soil	1161	N. Mallikharjuna Rao
70.	Nalgonda	Telangana	Cotton, Paddy, Pigeonpea and Greengram	Sandy loam, light black to medium black soils	740	R Veeraiah
Zone VI						
71.	Valsad	Gujarat	Paddy, Chickpea, Pigeonpea, Blackgram and Sugarcane	Medium black	2208	R.F. Thakor

S. No.	KVK / District	State	Crops	Soil	Rainfall (mm)	Name of the Program Coordinator
72.	Rajkot	Gujarat	Cotton, Groundnut and Wheat	Medium & shallow black	635	B.B. Kabria
73.	Kutch	Gujarat	Castor, Cotton and Pearl millet	Sandy Loam	360	U.N. Tank
74.	Jhunjhunu	Rajasthan	Pearlmillet, Mustard, Cowpea, Cluster bean, Wheat and Chickpea	Sandy Loam	450	S.M. Mehta
75.	Bharatpur	Rajasthan	Pearlmillet, Sorghum, Wheat, Mustad and Barley	Alluvial	667	Amar Singh
76.	Jodhpur	Rajasthan	Mothbean, Pearl millet, Cluster bean and Greengram	Sandy Loam	318	M C Bhandari
77.	Kota	Rajasthan	Soybean, Blackgram, Wheat, Coriander, Chickpea, Mustard and Sesame	Black clay loam	745	Mahendra Singh Choudhari
Zone VII						
78.	Raipur	Chhattisgarh	Paddy, Wheat and Chickpea	Vertisols	1100	Amit Shukla
79.	Bilaspur	Chhattisgarh	Paddy, Wheat, Pigeonpea and Chickpea	Loamy	1260	R.N. Sharma
80.	Dantewada	Chhattisgarh	Paddy, Maize, Horse gram and Niger	Loamy	1390	Ratna Nashine
81.	Satna	Madhya Pradesh	Paddy, Pigeonpea, Chickpea and Wheat	Loamy	1100.3	R.S. Negi
82.	Guna	Madhya Pradesh	Soybean, Wheat, Chickpea and Coriander	Shallow to medium black	970	G.S. Kulmi
83.	Morena	Madhya Pradesh	Pearlmillet, Pigeonpea, Mustard and Wheat	Alluvial	701	S.P. Singh

S. No.	KVK / District	State	Crops	Soil	Rainfall (mm)	Name of the Program Coordinator
84.	Datia	Madhya Pradesh	Groundnut, Wheat, Chickpea and Sesame	Alfisols	743	R.K.S. Tomar
85.	Tikamgarh	Madhya Pradesh	Soybean, Wheat, Blackgram, Mustard and Sesame	Alfisols	846	S.S.Gautam
86.	Chhatarpur	Madhya Pradesh	Wheat, Sesame, Chickpea, Blackgram, Soybean, Groundnut and Barley	sandy loam	1075	Veena Pani Shrivastava
87.	Balaghat	Madhya Pradesh	Paddy, Wheat, Chickpea, Pigeonpea and Blackgram	sandy loam	1447	R.L.Raut
88.	Kendrapara	Odisha	Sugarcane, Blackgram, Greengram, Groundnut, Paddy and Jute	sandy loam	1556	Anjali Roy
89.	Jharsuguda	Odisha	Paddy and Maize	Red laterite	1023	Biswa Pattnaik
90.	Sonepur	Odisha	Paddy and Greengram	Red, brown forest	1293	Suraya-narayan
91.	Ganjam	Odisha	Paddy, Greengram, Groundut, Maize and Blackgram	Sandy-clay	1020	Rashant Panda
Zone VIII						
92.	Tumakuru	Karnataka	Groundnut, Maize, Fingermillet and Pigeonpea	Red loamy soils	696	N. Loganandhan
93.	Kolar	Karnataka	Paddy, Groundnut, Fingermillet and Pigeonpea	Red sandy loam	590	Manjunath Gowda
94.	Davangere	Karnataka	Maize, Cotton, Fingermillet, Sorghum, Redgram and Sugarcane	Red	590	Devaraja

S. No.	KVK / District	State	Crops	Soil	Rainfall (mm)	Name of the Program Coordinator
95.	Belgaum	Karnataka	Maize, Sunflower, Groundnut, Wheat, Chickpea and Sugarcane	Red and black	439	S. Shasi Kumar
96.	Alleppey	Kerala	Paddy and Banana	Clayey alluvial	2809	P. Murali-dharan
97.	Namakkal	Tamilnadu	Sorghum and Groundnut	Sandy loam	400	B. Mohan
98.	Thiruvarur	Tamilnadu				R Bhaskaran
99.	Ramanatha-puram	Tamilnadu	Paddy, Cotton, Foxtail millet, Fingermillet and Sorghum	Sandy loam & clay loam	850	R. Durai Singh
100.	Villupuram	Tamilnadu	Paddy, Groundnut, Sugarcane & Blackgram	Sandy clay loam	1067	R. Vaidhya-nathan

New NICRA KVKs (2015-16)

S. No.	Name of the KVK	State	Name of the Program Coordinator
Zone-I			
1.	Bandipora	Jammu & Kashmir	A.H. Hakeem
Zone-II			
2.	Banka	Bihar	Kumari Sarada
3.	Godda	Jharkhand	Ravi Shankar
Zone-III			
4.	Karbi-Anglong	Assam	A.K. Deka
5.	Ukhrul	Manipur	L. Loken Singh
6.	Serchhip	Mizoram	Lalnunpuii Parte
7.	Jaintia Hills	Meghalaya	M.J. Syngkon
8.	Mon	Nagaland	Ruokuovilie Mezhatus
9.	Dhalai	Tripura	Subrata Shib
Zone-IV			
10.	Kaushambi	Uttar Pradesh	Ajay Kumar
11.	Pratapgarh	Uttar Pradesh	A.K. Srivastava
Zone-V			
12.	Chittoor	Andhra Pradesh	C Manohar Raju
13.	Jalna	Maharashtra	Krishna Vishwanath Sonune
Zone-VI			
14.	Amreli	Gujarat	N.S. Joshi
15.	Banaskantha	Gujarat	A.J. Patel
16.	Barmer	Rajasthan	Pradeep Pagaria
Zone-VII			
17.	Ratlam	Madhya Pradesh	M.K. Shrivastava
18.	Jhabua	Madhya Pradesh	I.S. Tomar
19.	Kalahandi	Odisha	R.K. Tarai
Zone-VIII			
20.	Gadag	Karnataka	L.G. Hire-goudar
21.	Kalburgi (Gulbarga)	Karnataka	Raju Teggelli

Annexure II

15. Budget Utilization 2014-15

(Rupees in lakhs)

S.No.	Zone	Sanctioned budget	Expenditure
1	I	150.20	117.02
2	II	191.00	174.58
3	III	142.00	134.87
4	IV	95.50	74.14
5	V	161.00	128.84
6	VI	74.00	64.31
7	VII	126.49	91.02
8	VIII	121.01	113.61
	Total	**1061.20**	**898.39**

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